ANTIMONY TRIOXIDE

HSDB - Hazardous Substances Data Bank

0.0 ADMINISTRATIVE INFORMATION

Hazardous Substances Data Bank Number: 436
Last Revision Date: 970813
Review Date: Reviewed by SRP on 6/2/89.
Update History:

1 Field Update on 08/13/97, 5 fields added/edited/deleted.
2 Complete Update on 04/01/97, 2 fields added/edited/deleted.
3 Complete Update on 06/18/96, 2 fields added/edited/deleted.
4 Complete Update on 04/12/96, 1 field added/edited/deleted.
5 Complete Update on 01/19/96, 1 field added/edited/deleted.
6 Complete Update on 11/10/95, 1 field added/edited/deleted.
7 Complete Update on 02/16/95, 1 field added/edited/deleted.
8 Complete Update on 01/18/95, 1 field added/edited/deleted.
9 Complete Update on 12/21/94, 1 field added/edited/deleted.
10 Complete Update on 09/13/94, 2 fields added/edited/deleted.
11 Complete Update on 06/29/94, 1 field added/edited/deleted.
12 Complete Update on 05/05/94, 1 field added/edited/deleted.
13 Complete Update on 03/25/94, 1 field added/edited/deleted.
14 Complete Update on 11/05/93, 1 field added/edited/deleted.
15 Complete Update on 08/07/93, 1 field added/edited/deleted.
16 Field update on 12/12/92, 1 field added/edited/deleted.
17 Complete Update on 04/27/92, 1 field added/edited/deleted.
18 Complete Update on 01/23/92, 1 field added/edited/deleted.
19 Complete Update on 10/22/90, 71 fields added/edited/deleted.
20 Field Update on 01/15/90, 1 field added/edited/deleted.
21 Complete Update on 01/11/90, 72 fields added/edited/deleted.
22 Complete Update on 03/31/86

1.0 SUBSTANCE IDENTIFICATION

Name of Substance: ANTIMONY TRIOXIDE
CAS Registry Number: 1309-64-4
Related HSDB Records: [ANTIMONY]
Synonyms:

1 Extrema [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
2 A 1530 [Peer Reviewed]
3 A 1582 [Peer Reviewed]
4 A 1588LP [Peer Reviewed]
5 ANTIMONIOUS OXIDE [Peer Reviewed]
6 ANTIMONY OXIDE [Peer Reviewed]
7 ANTIMONY OXIDE (O3SB2) [Peer Reviewed]
8 ANTIMONY OXIDE (SB2O3) [Peer Reviewed]
9 ANTIMONY PEROXIDE [Peer Reviewed]
10 ANTIMONY SESQUIOXIDE [Peer Reviewed]
11 ANTIMONY WHITE [Peer Reviewed]

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11 ANTIMONY WHITE [Peer Reviewed]
12 ANTIMONY(3+) OXIDE [Peer Reviewed]
13 ANTOX [Peer Reviewed]
14 AP 50 [Peer Reviewed]
15 CHEMETRON FIRE SHIELD [Peer Reviewed]
16 CI 77052 [Peer Reviewed]
17 CI PIGMENT WHITE 11 [Peer Reviewed]
18 DECHLORANE A-O [Peer Reviewed]
19 DIANTIMONY TRIOXIDE [Peer Reviewed]
20 EXITELITE [Peer Reviewed]
21 FLOWERS OF ANTIMONY [Peer Reviewed]
22 NCI-C55152 [Peer Reviewed]
23 NYACOL A 1530 [Peer Reviewed]
24 Nyacol A 1510LP [Peer Reviewed]
25 SENARMONTITE [Peer Reviewed]
26 THERMOGUARD B [Peer Reviewed]
27 THERMOGUARD S [Peer Reviewed]
28 TIMONOX [Peer Reviewed]
29 VALENTINITE [Peer Reviewed]
30 WEISSPIESSGLANZ (German) [Peer Reviewed]

Molecular Formula: O3-Sb2 [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 104*
Wiswesser Line Notation: .SB2.O3 [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety Health. Registry ofToxic Effects of Chemical Substances (RTECS). National Library of Medicine's current MEDLARS fi*
RTECS Number: NIOSH/CC5650000
OHM-TADS Number: 7217222

2.0 MANUFACTURING/USE INFORMATION

Methods of Manufacturing:

1 REACTION OF ANTIMONY METAL WITH AIR OR OXYGEN; ROASTING OF ANTIMONY TRISULFIDE; ALKALINE HYDROLYSIS OF AN ANTIMONY TRIHALIDE FOLLOWED BY DEHYDRATION OF INTERMED. [Peer Reviewed] *SRI*
2 OBTAINED FROM ANTIMONY ORE MINERALS BY VOLATILIZATION (ROASTING) PROCESS: LD FREEDMAN IN KIRK-OTHMER ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY, VOL 3 (INTERSCIENCE, NEW YORK, 3RD ED PAGE 107 (1978). LAB PREPARATION FROM ANTIMONY TRICHLORIDE AND WATER: SCHENK IN HANDBOOK OF PREPARATIVE INORGANIC CHEM, VOL 1, G BRAUER, ED (ACADEMIC PRESS, NY, 2ND ED, 1963) P 615. [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 104*

Impurities:

Trace impurities such as arsenic, copper, iron, lead, and nickel [Peer Reviewed] *CHEMICAL PRODUCTS SYNOPSIS: Antimony Oxide, 1985*

Formulations/Preparations:

1 Most commercial grades contain 99.2-99.5% antimony trioxide. [Peer Reviewed] *CHEMICAL PRODUCTS SYNOPSIS: Antimony Oxide, 1985*
2 Grade: technical, pigment [Peer Reviewed] *Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 91*

Manufacturers:

1 Air Products and Chemicals, Inc, Hq, PO Box 538, Allentown, PA 18195, (215) 481-4911; Subsidiary: JC Schumacher Co, 1969 Palomar Oaks Way, Carlsbad, CA 92008, (619) 931-9555 [Not Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 470*

2 Amspec Chemical Corp, Hq, Foot of Water St, Gloucester City, NJ 08030, (609) 456-3930 [Not Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 470*

3 Cookson America Inc, Hq, 170 Westminster St, Providence, RI (401) 521-1000; Subsidiary: Anzon Inc, Hq, 2545 Aramango Ave, Philadelphia, PA 19125; Production sites: Larado, TX 78040; Philadelphia, PA 19215 [Not Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 470*

4 ASARCO Inc, Hq, 180 Maiden Ln, New York, NY 10038, (212) 510-2000; Production site: 5th and Douglas Sts, Omaha, NE 68102 [Not Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 470*

5 The Bernuth Corp, Hq, 2600 Douglas Rd, Suite 810, Coral Gables, FL 33134, (305) 444-8445; Subsidiary: Bernuth, Lembcke Co, Inc, 1360 Post Oak Blvd, Suite 1480, Houston, TX 77056, (713) 850-1200; Production site: Memphis, TN 38100 [Not Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 470*

6 Laurel Industries Inc, Hq, 29525 Chagrin Blvd, Suite 206, Cleveland, OH 44122, (216) 831-5747; Production site: La Porte, TX 77571 [Not Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 470*

7 M&T Chemicals Inc, Hq, Woodbridge Rd & Randolph Ave, PO Box 1104, Rahway, NJ 07065, (201) 499-0200; Production site: 1900 Chesapeake Ave, Baltimore, MD 21226 [Not Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 470*

8 The Proctor and Gamble Co, Hq, 301 E Sixth St, PO Box 599, Cincinnati, OH 45201, (513) 983-5607; Subsidiary: Richardson-Vicks, Inc, One Far Mill Crossing, Shelton, CT 06484, (203) 929-2500; JT Baker, Inc, subsidiary, (201) 859-2151; Production site: 222 Red School Lane, Phillipsburg, NJ 08865 [Not Reviewed] *SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. 470*

Major Uses:

1 As an opacifier which does not fuse at the furnace temp, and which remains dispersed in the vitreous coating [Peer Reviewed] *Browning, E. Toxicity of Industrial Metals. 2nd ed. New York: Appleton-Century-Crofts, 1969. 28*

2 AS PAINT PIGMENT; IN ENAMELS & GLASSES; AS MORDANT; IN FLAME-PROOFING CANVAS [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 104*

3 STAINING IRON & COPPER; PHOSPHORS [Peer Reviewed] *Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 91*

4 FLAME RETARDANT-EG, IN FABRICS, RESINS, & WOOD COATINGS; CATALYST-EG, IN PLASTICS; CERAMICS, & PLASTICS; CHEM INTERMED FOR POTASSIUM ANTIMONY TARTRATE; RAW MATERIAL IN MFR OF ANTIMONY METAL [Peer Reviewed] *SRI*

Consumption Patterns:

1 FLAME RETARDANT, 90%; OTHER USES, 10% (1977) [Peer Reviewed] *SRI*

2 Flame retardent, 76%; catalyst, 6%; pigments, 5%; glass, 8%; miscellaneous, 5% (1985) [Peer Reviewed] *CHEMICAL PRODUCTS SYNOPSIS: Antimony Oxide, 1985*

U.S. Production:

1 (1977) 9.0X10+9 G (ANTIMONY CONTENT) [Peer Reviewed] *SRI*

2 (1982) 1.05X10+10 G (ANTIMONY CONTENT) [Peer Reviewed] *SRI*

2 (1982) 1.05X10+10 G (ANTIMONY CONTENT) [Peer Reviewed] *SRI*
3 (1985) 1.41X10+10 g [Peer Reviewed] *CHEMICAL PRODUCTS SYNOPSIS: Antimony Oxide, 1985*

U.S. Imports:
1 (1978) 9.68X10+9 G [Peer Reviewed] *SRI*
2 (1983) 9.63X10+9 G [Peer Reviewed] *SRI*
3 (1985) 9.64X10+9 g [Peer Reviewed] *BUREAU OF THE CENSUS. U.S. IMPORTS FOR CONSUMPTION AND GENERAL IMPORTS 1985 p.1-567*
4 (1986) 27,042,802 lb [Peer Reviewed] *BUREAU OF THE CENSUS. US IMPORTS FOR CONSUMPTION AND GENERAL IMPORTS 1986 P. 1-513*

U.S. Exports:
1 (1988) 399,278 lb [Peer Reviewed] *BUREAU OF THE CENSUS. U.S. EXPORTS, SCHEDULE E, JULY 1988, p. 2-93*
2 (1985) 6.77X10+7 g [Peer Reviewed] *BUREAU OF THE CENSUS. U.S. EXPORTS, SCHEDULE E, 1985 p.2-88*

3.0 CHEMICAL AND PHYSICAL PROPERTIES

Color/Form:
1 CRYSTALS, POLYMORPHIC [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 104*
2 WHITE CRYSTALLINE POWDER [Peer Reviewed] *Browning, E. Toxicity of Industrial Metals. 2nd ed. New York: Appleton-Century-Crofts, 1969. 24*

Odor: ODORLESS [Peer Reviewed] *Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 91*
Boiling Point: 1425 DEG C [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 104*
Melting Point: 655 DEG C [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 104*
Molecular Weight: 291.52 [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co , Inc., 1983. 104*
Heat of Vaporization: 17.82 KCAL/MOL [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 104*
Solubilities:
1 VERY SLIGHTLY SOL IN COLD WATER, SLIGHTLY SOL IN HOT; SOL IN POTASSIUM HYDROXIDE SOLUTION, HYDROCHLORIC ACID, ACETIC ACID [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-73*
2 SLIGHTLY SOL IN DIL SULFURIC ACID, & NITRIC ACID; SOL IN WARM TARTARIC ACID SOLN, & BITARTRATES SOLN; SOLUBILITY IN HYDROCHLORIDE ACID INCR WITH INCREASING CONCN OF HYDROCHLORIC ACID; SOL IN SOLN OF ALKALI HYDROXIDES OR SULFIDES [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 104*

Vapor Pressure: 1 MM HG AT 574 DEG C [Peer Reviewed] *Sax, N.I. Dangerous Properties of Industrial Materials. 5th ed. New York: Van Nostrand Rheinhold, 1979. 385*
Other Chemical/Physical Properties:
1 At higher temp, the stable form is valentinite which consists of infinite double chains. The orthorhombic modification is metastable below 570 deg C .... [Peer Reviewed] *Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. 3(78) 108*
2 Antimony trioxide melts in the absence of oxygen at 656 deg C and partially sublimes before

2 Antimony trioxide melts in the absence of oxygen at 656 deg C and partially sublimes before reaching the boiling temp, 1425 deg C. The vapor at 1500 deg C consists largely of ... /two/ molecules of antimony trioxide (Sb_4O_6), but these dissociate at higher temp to form /single/ SbO_3 molecules. [Peer Reviewed] *Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. 3(78) 108*

3 Amphoteric [Peer Reviewed] *Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 91*

4 INDEX OF REFRACTION: 2.087; DENSITY: 5.2; WHITE CUBES (SENARMONTITE); INDEX OF REFRACTION: 2.18, 2.35; DENSITY: 5.67; COLORLESS, RHOMBIC CRYSTALS (VALENTINITE) [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. B-73*

5 HEAT CAPACITY @ 21 DEG C (294.4 DEG K): 24.11 CAL/G-ATOM/DEG C; SUBLIMES AT 400 DEG C IN HIGH VACUUM; EXISTS IN VAPOR PHASE AS SB4O6 (ANTIMONY TRIOXIDE). [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 104*

6 Temp of transition: 928 deg K; Heat of transition: 14.74 kcal/g mole; Entropy of transition (eu): 15.88; Entropy (eu): 29.4 @ 298 deg K /solid/; Temp of transition: 1698 deg K; Heat of transition: 8.92 kcal/g mole; Entropy of transition (eu): 5.25; Entropy (eu) @ 298 deg K: NA; /Liquid/ [Peer Reviewed] *Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. D-48*

4.0 SAFETY AND HANDLING

EMERGENCY GUIDELINES

DOT Emergency Guidelines:

1 Fire or explosion: Some may burn but none ignite readily. Some may polymerize (P) explosively when heated or involved in a fire. Containers may explode when heated. Some may be transported hot. [QC Reviewed] *U.S. Department of Transportation. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Spe*

2 Health: Inhalation of material may be harmful. Contact may cause burns to skin and eyes. Inhalation of asbestos dust may have a damaging effect on the lungs. Fire may produce irritating, corrosive and/or toxic gases. Runoff from fire control may cause pollution. [QC Reviewed] *U.S. Department of Transportation. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Spe*

3 Public safety: CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover. Isolate spill or leak area immediately for at least 10 to 25 meters (30 to 80 feet) in all directions. Keep unauthorized personnel away. Stay upwind. [QC Reviewed] *U.S. Department of Transportation. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Spe*

4 Protective clothing: Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters' protective clothing will only provide limited protection. [QC Reviewed] *U.S. Department of Transportation. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Spe*

5 Evacuation: Fire: If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all

5 (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. [QC Reviewed] *U.S. Department of Transportation. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Spe*

6 Fire: Small fires: Dry chemical, CO2, water spray or regular foam. Large fires: Water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Do not scatter spilled material with high pressure water streams. Dike fire-control water for later disposal. Fire involving tanks: Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from the ends of tanks. [QC Reviewed] *U.S. Department of Transportation. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Spe*

7 Spill or leak: Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent dust cloud. Avoid inhalation of asbestos dust. Small dry spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area. Small spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal. Large spills: Dike far ahead of liquid spill for later disposal. Cover powder spill with plastic sheet or tarp to minimize spreading. Prevent entry into waterways, sewers, basements or confined areas. [QC Reviewed] *U.S. Department of Transportation. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Spe*

8 First aid: Move victim to fresh air. Call emergency medical care. Apply artificial respiration if victim is not breathing. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. [QC Reviewed] *U.S Department of Transportation. 1996 North American Emergency Response Guidebook. A Guidebook for First Responders During the Initial Phase of aHazardous Materials/Dangerous Goods Incident. U.S. Department of Transportation (U.S. DOT) Research and Spe*

FLAMMABLE PROPERTIES

Fire Potential:

WHEN POWDERED ANTIMONY TRIOXIDE IS HEATED IN AIR, IT IGNITES & BURNS. [Peer Reviewed] *National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 9th ed. Boston, MA: National Fire Protection Association, 1986.,p. 491M-26*

FIRE FIGHTING INFORMATION

Fire Fighting Procedures:

If material involved in fire: Extinguish fire using agent suitable for type of surrounding fire (Material itself does not burn or burns with difficulty). [Peer Reviewed] *Association of American Railroads. Emergency Handling of Hazardous Materials in Surface Transportation. Washington, D.C.: Assoc. of American Railroads,Hazardous Materials Systems (BOE), 1987. 60*

HAZARDOUS REACTIONS

Reactivities and Incompatibilities:

TRIVALENT ANTIMONY CMPD TEND TO FORM EXPLOSIVE MIXTURES WITH PERCHLORIC ACID WHEN HOT. /TRIVALENT ANTIMONY CMPD/ [Peer Reviewed] *National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 9th ed. Boston, MA: National Fire Protection Association, 1986.,p. 491M-25*

PREVENTIVE MEASURES

Protective Equipment and Clothing:

1 Wear appropriate chemical protective gloves, boots and goggles. [Peer Reviewed] *Association of American Railroads. Emergency Handling of Hazardous Materials in Surface Transportation. Washington, D.C.: Assoc. of American Railroads,Hazardous Materials Systems (BOE), 1987. 60*

2 NIOSH: Respirator selection: 5 mg/cu m: Any dust and mist respirator except single-use and quarter-mask respirators or any supplied-air respirator or self-contained breathing apparatus; 12.5 mg/cu m: any powered air-purifying respirator with a dust and mist filter or any supplied-air respirator operated in continuous-flow mode; 25 mg/cu m: any air-purifying full facepiece respirator with a high-efficiency particulate filter or any powered air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter or any supplied-air respirator with tight-fitting facepiece operated in a continuous flow mode or any self-contained breathing apparatus with full facepiece or any supplied-air respirator with full facepiece or supplied air-respirator with full facepiece; 80 mg/cu m: any supplied-air respirator with a half-mask and operated in pressure demand or other positive pressure mode. Emergency or planned entry in unknown concentration or IDLH conditions: any self-contained breathing apparatus with a full facepiece and operated in pressure-demand or other positive pressure mode; or any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. ESCAPE: any appropriate escape-type self-contained breathing apparatus or any air-purifying full facepiece respirator with a high-efficiency particulate filter. /Antimony and compounds (as Sb)/ [Peer Reviewed] *NIOSH. Pocket Guide to Chemical Hazards. 2nd Printing. DHHS (NIOSH) Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services, NIOSH/Supt.of Documents, GPO, February 1987. 53*

Other Preventative Measures:

If material not involved in fire: Keep material out of water sources and sewers. Build dikes to contain flow as necessary. Keep upwind. Avoid breathing vapors or dusts. Wash away any material which may have contacted the body with copious amounts of water or soap and water. [Peer Reviewed] *Association of American Railroads. Emergency Handling of Hazardous Materials in Surface Transportation. Washington, D.C.: Assoc. of American Railroads,Hazardous Materials Systems (BOE), 1987. 605*

OTHER SAFETY AND HANDLING

Shipment Methods and Regulations:

1 No person may /transport,/ offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177)./ [QC Reviewed] *49 CFR 171.2 (7/1/96)*

Reviewed] *49 CFR 171.2 (7/1/96)*

2 The International Maritime Dangerous Goods Code lays down basic principles for transporting hazardous chemicals. Detailed recommendations for individual substances and a number of recommendations for good practice are included in the classes dealing with such substances. A general index of technical names has also been compiled. This index should always be consulted when attempting to locate the appropriate procedures to be used when shipping any substance or article. [QC Reviewed] *IMDG; International Maritime Dangerous Goods Code; International Maritime Organization p.6064 (1988)*

Storage Conditions:

MATERIALS WHICH ARE TOXIC AS STORED OR WHICH CAN DECOMPOSE INTO TOXIC COMPONENTS ... SHOULD BE STORED IN A COOL WELL VENTILATED PLACE, OUT OF THE DIRECT RAYS OF THE SUN, AWAY FROM AREAS OF HIGH FIRE HAZARD, AND SHOULD BE PERIODICALLY INSPECTED. INCOMPATIBLE MATERIALS SHOULD BE ISOLATED ... . /ANTIMONY CMPD/ [Peer Reviewed] *Sax, N.I. Dangerous Properties of Industrial Materials. 4th ed. New York: Van Nostrand Reinhold, 1975. 262*

Cleanup Methods:

1 Environmental considerations--land spill: Dig a pit, pond, lagoon, holding area to contain liquid or solid material. /SRP: If time permits, pits, ponds, lagoons, soak holes, or holding areas should be sealed with an impermeable flexible membrane liner./ Cover solids with a plastic sheet to prevent dissolving in rain or fire fighting water. [Peer Reviewed] *Association of American Railroads. Emergency Handling of Hazardous Materials in Surface Transportation. Washington, D.C.: Assoc. of American Railroads,Hazardous Materials Systems (BOE), 1987. 60*

2 Environmental considerations--water spill: Add dilute caustic soda (NaOH). If dissolved, apply sodium sulfide (Na2S) solution to preciptate heavy metals. Allow to aerate. Use mechanical dredges or lifts to remove immobilized masses of pollutants and precipitates. [Peer Reviewed] *Association of American Railroads. Emergency Handling of Hazardous Materials in Surface Transportation. Washington, D.C.: Assoc. of American Railroads,Hazardous Materials Systems (BOE), 1987. 60*

Disposal Methods:

SRP: At the time of review, criteria for land treatment or burial (sanitary landfill) disposal practices are subject to significant revision. Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices. [Peer Reviewed]

5.0 TOXICITY/BIOMEDICAL EFFECTS

SUMMARY

Evidence for Carcinogenicity:

1 Evaluation: There is inadequate evidence for the carcinogenicity of antimony trioxide and antimony trisulfide in humans. There is sufficient evidence for the carcinogenicity of antimony trioxide in experimental animals. There is limited evidence for the carcinogenicity of antimony trisulfide in experimental animals. Overall evaluations: Antimony trioxide is probably carcinogenic to humans (Group 2B). Antimony trisulfide is not classifiable as to its carcinogenicity to humans (Group 3). [QC Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. 47 302 (1989)*

2 A2. A2= Suspected human carcinogen. (1980) /Antimony trioxide production/ [QC Reviewed]

2 A2. A2= Suspected human carcinogen. (1980) /Antimony trioxide production/ [QC Reviewed] *American Conference of Governmental Industrial Hygienists. Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and BiologicalExposure Indices (BEIs) for 1995-1996. Cincinnati, OH: ACGIH, 1995. 13*

TOXICITY EXCERPTS

Human Toxicity Excerpts:

1 ... /IN/ A PLANT MANUFACTURING ANTIMONY TRIOXIDE ... MEN ... CAME INTO CONTACT WITH BOTH DUST AND FUMES ... SKIN, EXCEPT FOR A SMALL PATCH OF IRRITATION IN 2 MEN, /WAS/ QUITE NORMAL, AND THESE MEN, IN SPITE OF A HIGH FECAL EXCRETION OF ANTIMONY FROM 10.3 TO 97.8 MG/DAY SHOWED NO OTHER SYMPTOMS OF POISONING. [Peer Reviewed] *Browning, E. Toxicity of Industrial Metals. 2nd ed. New York: Appleton-Century-Crofts, 1969. 33*

2 ... EFFECT OF ANTIMONY WAS REPORTED FROM THE SOVIET UNION OF HIGHER RATES OF SPONTANEOUS LATE ABORTIONS (12.5 VS 4.1%), PREMATURE BIRTHS (3.4 VS 1.2%), AND GYNECOLOGIC PROBLEMS (77.5 VS 56%) AMONG FEMALE METALLURGIC WORKERS EXPOSED TO THE ANTIMONY AEROSOLS. ANTIMONY CONCENTRATIONS WERE NOT SPECIFIED, BUT AIR SAMPLES WERE REPORTED TO CONTAIN METALLIC DUST AND ANTIMONY TRIOXIDE AND PENTASULFIDE. WEIGHTS OF CHILDREN BEGAN TO LAG BEHIND THOSE OF CONTROL BABIES AT 3 MONTHS, AND WERE SIGNIFICANTLY REDUCED AT 1 YEAR. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 1515*

3 Fifty-one workers (ages 31-54, mean 45.23 years) in an antimony smelting plant (worked 9-31 years, mean 17.91 years), were exposed to airborne dust containing up to 88% antimony trioxide and the remainder, antimony pentoxide. Pneumoconiotic changes were seen in the lung after 1 decade of employment. No systemic changes were seen except for "antimony dermatosis." No massive lung fibrosis was noted. Diffuse, densely distributed puntate opacities, diameter <1 mm, concentrated in mid-lung were found. Enlarged dense hilar shadows and emphysematous changes were seen. Chronic coughing (60.8%), conjunctivitis (27.5%), antimony dermatosis (32/51), upper airway inflammation (35.3%), chronic bronchitis (37.3%), chronic emphysema (34.5%), and pleural adhesions (27.3%) were observed. No malignant lesions were noted. [Peer Reviewed] *Potkonjak V, Pavlovich M; Int Arch Occup Environ Health 51: 199-207 (1983) as cited in USEPA; Health and Environmental Effects Profile for Antimony Oxides p.69 (1985) EPA 600/x-85/271*

4 Violent vomiting due to mucosal irritation is the main symptom of acute oral antimony intoxication. The vomit contains sloughed mucosal cells and most of the toxic antimony; diarrhea and lowered resp rate lead to death. Myocardial edema, hyperemia, and capillary engorgement also contribute to the fatality. Symptoms of chronic antimony intoxication are dyspnea, weight and hair loss, papular eruptions on the skin, jaundice, albuminuria, damage to the heart and liver, hyperplasia of the spleen, glomerular nephritis, abnormal incr in erythrocytes, and decrease in leukocytes. Chronic inhalation of subtoxic doses of antimony salts causes interstitial pneumonitis, intraalveolar lipoid deposits, and liver and cardiac damage. /Antimony salts/ [Peer Reviewed] *Luckey, T.D. and B. Venugopal. Metal Toxicity in Mammals, 1. New York: Plenum Press, 1977. 179*

5 ... ANTIMONY POISONING CLOSELY PARALLELS ARSENIC POISONING EXCEPT THAT VOMITING FROM ANTIMONY MAY BE MORE PROMINENT, PERHAPS BECAUSE ITS CMPD ARE LESS READILY ABSORBED THAN ARSENICALS. ... TRIVALENT ANTIMONY CMPD ... ARE MANY TIMES MORE LETHAL THAN PENTAVALENT DERIV. ... TOLERANCE TO ANTIMONY IS DENIED. /ANTIMONY SALTS/ [Peer Reviewed] *Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.,p. II-133*

6 BECAUSE OF ASSOCIATION WITH LEAD AND ARSENIC IN INDUSTRY, IT IS OFTEN

6 BECAUSE OF ASSOCIATION WITH LEAD AND ARSENIC IN INDUSTRY, IT IS OFTEN DIFFICULT TO ASSESS THE TOXICITY OF ANTIMONY ... . /ANTIMONY CMPD/ [Peer Reviewed] *Sax, N.I. Dangerous Properties of Industrial Materials. 6th ed. New York, NY: Van Nostrand Reinhold, 1984. 301*

7 ... Described are irritant effects of antimony on the mucous membranes of the eyes, nose, mouth, throat, and upper respiratory tract, the latter effects from acute exposures to the halides and chronic exposures to the oxides. /Antimony halides and oxides/ [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 1514*

8 It is known that some antimony miners have developed a disabling form of silicosis but owning to the fact that antimony is not permanently retained in the lung but is constantly excreted in small amounts in the urine and feces, it is generally believed that this is a benign condition. [Peer Reviewed] *Browning, E. Toxicity of Industrial Metals. 2nd ed. New York: Appleton-Century-Crofts, 1969. 32*

9 ANTIMONY AND ITS COMPOUNDS REPORTED TO CAUSE DERMATITIS, KERATITIS, CONJUNCTIVITIS, & NASAL SEPTAL ULCERATION BY CONTACT, FUMES OR DUST. /ANTIMONY AND ANTIMONY CMPD/ [Peer Reviewed] *The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 102*

10 CONTRACTABILITY & ELECTRIC ACTIVITY OF MYOCARDIUM WAS LOWER & EXCITABILITY HIGHER IN WORKERS THAN IN CONTROLS. /ANTIMONY AND ANTIMONY CMPD/ [Peer Reviewed] *BESKROVNAYA VM; SOV ZDRAVOOKHR KIRG 1: 11-4 (1972)*

11 DUST ENCOUNTERED IN ANTIMONY MINING MAY CONTAIN FREE SILICA & CASES OF PNEUMOCONIOSIS TERMED "SILICO-ANTIMONIOSIS" HAVE BEEN REPORTED AMONG ANTIMONY MINERS. DURING PROCESSING, ANTIMONY ORE ... IS CONVERTED INTO FINE DUST ... LEADING TO HIGH ATMOSPHERIC CONCN OF FINE DUST. [Peer Reviewed] *International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983. 177*

12 Oral. ... Seventy people who drank lemonade from preparations left overnight in white enamelware buckets (the enamel contained 2.88% antimony trioxide) became ill. Antimony trioxide had been leached from the enamel by the acidic lemonade. Fifty-six people were hospitalized, suffering from burning stomach pains, colic, nausea and vomiting; most recovered within 3 hours. Analysis found that the lemonade contained 0.013% antimony. Each person ingesting 300 ml lemonade would have received 36 mg antimony, which is similar to an emetic dose listed in the British Pharmacopoeia. [Peer Reviewed] *Dunn JJ; Analyst 53: 532-33 (1928) and Monier-Williams GW; Report on Public Health and Medical Subjects No. 73 Ministry of Health, London (1934) as cited in USEPA; Health Effects Assessment for Antimony and Compounds p.7 (1987) EPA 600/8-88/018*

Non-Human Toxicity Excerpts:

1 Antimony trioxide ... well tolerated by rats in dosages up to 4 mg daily ... . [Peer Reviewed] *Browning, E. Toxicity of Industrial Metals. 2nd ed. New York: Appleton-Century-Crofts, 1969. 29*

2 RABBITS FED DAILY UP TO 150 MG/KG ... FOR 4 WEEKS SHOWED NO PATHOLOGIC CHANGES. [Peer Reviewed] *Patty, F. (ed.). Industrial Hygiene and Toxicology: Volume II: Toxicology. 2nd ed. New York: Interscience Publishers, 1963. 995*

3 ... OCCASIONAL EXPOSURES (1 HOUR EACH 2 MONTHS FOR 1 YEAR) OF ADULT, ALBINO MALE AND FEMALE RATS AT HUGE DOSES (1700 MG ANTIMONY TRIOXIDE/CU M CONTAINING 2000 PPM ARSENIC, 1200 PPM LEAD) RESULTED IN NO EVIDENCE OF CHRONIC PNEUMONITIS, EITHER CELLULAR, COLLAGENOUS, OR FIBROTIC, INDICATING ANTIMONY TRIOXIDE DUST TO BE RELATIVELY INERT IN THE LUNG OF ALBINO RATS; ONLY SCATTERED DEPOSITS OF DUST PARTICULATES WERE FOUND LOCALIZED IN PHAGOCYTIC CELLS WITHIN THE ALVEOLAR SPACES AND SEPTA. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 1510*

Sons, 1981-1982. 1510

4 AN ACUTE INHALATION STUDY OF 4 HR DURATION IN RATS RESULTED IN NO DEATHS OR ADVERSE EFFECTS OTHER THAN MINIMAL TO SLIGHT FOCAL DISCOLORATION & PUFFY WHITE FOCI IN LUNG IN MOST ANIMALS AT A LEVEL OF 2,760 MG/CU M AVERAGE DUST CONCN. [Peer Reviewed] *American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values, 4th ed., 1980. Cincinnati, Ohio: American Conference ofGovernmmental Industrial Hygienists, Inc., 1980. 20*

5 Rats and rabbits exposed to antimony trioxide (90-125 mg antimony trioxide/cu m during 100 hr/month) for periods of up to 14 months, in addition to pneumonitis, also developed lipoid pneumonia, fibrous thickening of alveolar walls, and focal fibrosis. Rabbits appeared to be more susceptible than rats. [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 35*

6 ... Guinea pigs /were exposed/ to a dust concentration of antimony trioxide of 45.4 mg/cu m of air, for 2 hr daily 7 days a week for the first 3 weeks, later for 3 hr daily; this corresponded to an estimated daily retention of 1.6 mg. All the animals showed extensive interstitial pneumonitis, and 4 died during the period of exposure. ... No /cardiac/ lesions, as evidenced by the electrocardiogram, were observed. ... Fatty degeneration of the liver in 11 out of 15 guinea pigs having 138 or more hours of exposure was recorded. ... The blood picture ... showed ... a decrease in total white cells and polymorphonuclear leukocytes with a relative lymphocytosis. ... did not confirm the presence of eosinophilia. [Peer Reviewed] *Browning, E. Toxicity of Industrial Metals. 2nd ed. New York: Appleton-Century-Crofts, 1969. 30*

7 ... 148 female CDF rats and 8 miniature swine /were used/ to examine the long term toxicity of inhaled antimony trioxide. Both species were divided into a control group, a low-exposure (1.6 mg antimony/cu m) and a high exposure group (4.2 mg antimony/cu m). The animals were exposed 6 hr a day, on 5 days per week for 1 year. In the miniature swine, there were no histopathological changes in the lung, but in the rats there were pronounced morphological changes in the lung with focal fibrosis, adenomatous and pneumonocytic hyperplasia, and cholesterol clefts. The histopathological changes were most pronounced in the high exposure group. [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 35*

8 AFTER RATS WERE FED DIETARY ANTIMONY TRIOXIDE (1.0 & 2.0%) FOR 24 WK, ERYTHROCYTES WERE SIGNIFICANTLY DECREASED @ 2.0% & WHITE BLOOD CELLS WERE DECREASED @ 1.0%. GAMMA-GLUTAMYL TRANSPEPTIDASE WAS HIGH & ALKALINE PHOSPHATASE WAS ELEVATED @ 2.0% ANTIMONY TRIOXIDE. ANTIMONY LEVELS IN BLOOD, SPLEEN, LUNG, AND LIVER WERE 148.11, 61.88, 28.84, & 15.19 PPM RESPECTIVELY FOR THE 1% ANTIMONY TRIOXIDE DOSE AND 114.87, 55.71, 27.26, & 17.74 PPM RESPECTIVELY, FOR THE 2% ANTIMONY TRIOXIDE DOSE. THE TOXICITY OF ANTIMONY TRIOXIDE IN RATS SEEMED TO BE GENERALLY SLIGHT. [Peer Reviewed] *SUNAGAWA S; IGAKU KENKYU 51 (3): 129-42 (1981)*

9 BECAUSE OF THE POSSIBILITY THAT ARSENIC COULD ACT AS A COCARCINOGEN WHEN ANTIMONY DUSTS AND FUMES ARE INHALED, THE PHYSICAL STATE OF ARSENIC IN ANTIMONY TRIOXIDE WERE INVESTIGATED. EFFORTS TO REMOVE ARSENIC EITHER BY DISSOLUTION OR BY SUBLIMATION WERE UNSUCCESSFUL. ON BASIS OF THIS INFORMATION & NEGATIVE ACUTE, ORAL TOXICITY TESTS IN ANIMALS, IT WAS CONCLUDED THAT ARSENIC EXISTS IN ANTIMONY TRIOXIDE IN A PHYSICALLY & TOXICOLOGICALLY INERT FORM. [Peer Reviewed] *American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH:American Conference of Governmental Industrial Hygienists, 1986. 34*

10 Two groups of animals, each composed of 10 male and 10 female Sprague-Dawley rats (84 days old; males weighed 342-425 g, females weighed 227-276 g) were exposed to antimony by inhalation. A dosage of 1700 mg/cu m for 1 hour, 1-6 times every 2 months was used.

by inhalation. A dosage of 1700 mg/cu m for 1 hour, 1-6 times every 2 months was used. Animals were exposed to either antimony trioxide or powdered ore; exposure was for 66-311 days with the trioxide and 66-366 days with the powdered ore. Animals from each group were sacrificed periodically and examined. No experimental controls were used. Immediately after the first exposure, a transient and mild edema and lung congestion was seen with the powdered ore. A phagocytic response was seen in the lung in both groups of animals 66 days after the first exposure. As time of exposure increased, spleens exhibited scattered particles with moderate reticuloendothelial proliferation. No hepatic or renal pathology was noted. [Peer Reviewed] *Cooper DA et al; Am J Roentgenol Radium Ther Nucl Med 103: 495-508 (1986) as cited in USEPA; Health and Environmental Effects Profile for Antimony Oxides; p.63 (1985) EPA 600/x-85/271*

11 Signs of acute antimony poisoning /in rats/ were marked weight loss, loss of hair, and dry, scaly appearance of the skin. Eosinophilia /was/ the hematologic finding. Pathological findings consisted of acute congestion of the heart, liver, & kidneys. Death was from myocardial failure. This effect on heart muscle was felt ... to be diagnostic of antimony poisoning. Tissue analyses indicated very little storage of antimony. /Antimony and antimony cmpd/ [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 1510*

12 ... FOCAL PULMONARY HEMORRHAGE, FATTY DEGENERATION OF LIVER ... CHANGES IN PERIPHERAL BLOOD ... /REPORTED/ ... IN DIFFERENT SPECIES OF ANIMALS ... . /TRIVALENT ANTIMONY CMPD/ [Peer Reviewed] *Hamilton, A., and H. L. Hardy. Industrial Toxicology. 3rd ed. Acton, Mass.: Publishing Sciences Group, Inc., 1974. 29*

13 ... INJECTING TRIVALENT ANTIMONY CMPD SLOWLY INTO VEINS OF RABBITS, NOTED ... THE APPEARANCE OF NORMOBLASTS, STIPPLED CELLS, INCREASED NUMBER OF RETICULOCYTES & MYELOCYTES IN CIRCULATION WITHIN 24 HOURS. /TRIVALENT ANTIMONY CMPD/ [Peer Reviewed] *Browning, E. Toxicity of Industrial Metals. 2nd ed. New York: Appleton-Century-Crofts, 1969. 30*

14 Chronic inhalation of subtoxic doses of antimony salts causes interstitial pneumonitis, intraalveolar lipoid deposits, and liver and cardiac damage. /Antimony salts/ [Peer Reviewed] *Luckey, T.D. and B. Venugopal. Metal Toxicity in Mammals, 1. New York: Plenum Press, 1977. 179*

15 The highest concentrations of antimony in rats, given antimony in drinking water (38 ug/l) for 26 months, were found in the blood and spleen; 185 ug/kg and 31.5 ug/kg wet weight, respectively. /Sol antimony salts/ [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 30*

16 A concentration of 4 ppm antimony in culture solution has been shown to produce a toxic response in cabbage (Brassica oleracea) plants. [Peer Reviewed] *Brown, K.W., G. B. Evans, Jr., B.D. Frentrup (eds.). Hazardous Waste Land Treatment. Boston, MA: Butterworth Publishers, 1983. 237*

17 Rats were exposed to 5 ppm antimony in their drinking water. Endpoints monitored included body weights, blood pressure, serum chemistries including glucose, and urinalysis. Animals dying during the study were subjected to autopsy and grossly visible lesions were examined histopathologically. Both males and females exhibited significantly decreased longevity. Fasting serum glucose levels were not significantly different from controls in either sex. No effects were seen on blood pressure. Urinalysis did not reveal statistically significant differences. ... Water consumption for rats of the same strain handled in the same laboratory as 7.5 ml/100 g for females and 6.8 ml/100 g for males /was not reported/. These drinking rates would correspond to an estimated dose of 350 ug/kg bw/day. The finding of reduced longevity appears to be the most biologically significant finding. Failure to perform a complete histopathological workup is seen as a major deficiency in this study along with the single dose level and minimal reporting detail. /Antimony soluble salts/ [Peer Reviewed] *USEPA; Health Effects Assessment for Antimony and Compounds p.9-10 (1987) EPA 600/8-88/018*

18 Three groups of 8 month old Wistar derived rats (90 males and 90 females per group) were exposed by inhalation to either antimony trioxide (time-weighted average (TWA) 45 mg/cu

exposed by inhalation to either antimony trioxide (time-weighted average (TWA) 45 mg/cu m), antimony ore concentrate (TWA 36 + 40 mg/cu m), or filtered air (controls) for 7 hr/day, 5 day/wk, for up to 52 wk and sacrificed 20 wk after terminating exposures. The concentraion of antimony (Sb) in the lung of male rats (38,300 ug Sb/g) exposed to antimony trioxide was significantly greater than that in female rats (25,000 ug/g) exposed to antimony trioxide. The lung of both male and female rats exposed to antimony trioxide contained significantly more Sb than the lungs of males and females exposed to Sb ore (approx 5 times greater). The most significant findings were the presence of lung neoplasms in 27% of females exposed to antimony trioxide and 25% of females exposed to Sb ore concentrate. None of the male rats in any group or the female controls developed lung neoplasms. There were no significant differences in incidence of cancer of other organs between exposed and control rats. [Peer Reviewed] *Groth DH et al; J Toxicol Environ Health 18: 607-26 (1986)*

TOXICITY VALUES

Non-Human Toxicity Values:

1 LD50 Rat oral greater than 34,600 mg/kg [Peer Reviewed] *American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values, 4th ed., 1980. Cincinnati, Ohio: American Conference ofGovernmmental Industrial Hygienists, Inc., 1980. 21*

2 LD50 Rabbit percutaneous greater than 2,000 mg/kg [Peer Reviewed] *American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values, 4th ed., 1980. Cincinnati, Ohio: American Conference ofGovernmmental Industrial Hygienists, Inc., 1980. 21*

Ecotoxicity Values:

1 LD50 Lepomis macrochirus (bluegill sunfish) > 530 mg/l/96 hr. /Conditions of bioassay not specified/ [Peer Reviewed] *Buccafusco RJ; Bull Environ Contam Toxicol 26 (4): 446-52 (1981) as cited in USEPA; Health and Environmental Effects Profile for Antimony Oxides p.76 (1985) EPA 600/x-85/271*

2 LD50 Pimephales promelas (fathead minnow) > 833 mg/l/96 hr. /Conditions of bioassay not specified/ [Peer Reviewed] *Curtis MW, Ward CH; I Hydrol 51: 359-67 (1981) as cited in USEPA; Health and Enviromental Effects Profile for Antimony Oxides; p.76 (1985) EPA 600/x-85/271*

IARC Summary and Evaluation:

Evaluation: There is inadequate evidence for the carcinogenicity of antimony trioxide and antimony trisulfide in humans. There is sufficient evidence for the carcinogenicity of antimony trioxide in experimental animals. There is limited evidence for the carcinogenicity of antimony trisulfide in experimental animals. Overall evaluations: Antimony trioxide is probably carcinogenic to humans (Group 2B). Antimony trisulfide is not classifiable as to its carcinogenicity to humans (Group 3). [QC Reviewed] *IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. 47 302 (1989)*

PHARMACOKINETICS

Absorption, Distribution and Excretion:

1 ... NO PARTICULAR DIFFERENCE IN TISSUE DISTRIBUTION BETWEEN RABBIT AND RAT WAS NOTED WHEN ANIMALS WERE FED 2% ANTIMONY TRIOXIDE IN A CASEIN DIET. FOUND WERE MEAN AMOUNTS OF ANTIMONY FROM 6.7 TO 88 UG/G OF TISSUE OF SEVEN ANALYZED. THE LARGEST AMOUNTS WERE IN THE THYROID AND

TISSUE OF SEVEN ANALYZED. THE LARGEST AMOUNTS WERE IN THE THYROID AND ADRENAL GLANDS; SPLEEN, LIVER, LUNG, HEART, AND KIDNEY, IN THAT ORDER, HAD ABOUT 0.1 THE CONCENTRATION OF ANTIMONY, AS FOUND IN THE THYROID. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 1512*

2 Women working in an antimony metallurgical plant were compared with a similar group of women not exposed to antimony. ... Antimony concentrations in the blood of exposed workers were 10 times greater than controls. Urine levels of antimony ranged from 2.1-2.9 mg/100 ml. Analysis of biologic fluids detected antimony breast milk concentrations of 3.3 + or - 2 mg/l; placental tissue, 3.2-12.6 mg/100 ml; amniotic fluid, 6.2 + or - 2.8 mg/100 ml; and umbilical cord blood, 6.3 + or - 3 mg/100 ml. These women were exposed to unspecified amounts of antimony trioxide, metallic antimony, and antimony pentasulfides. [Peer Reviewed] *Belyaeva AP; Gig Truda Prof Zabol 11:32 (1967) as cited in USEPA; Health and Environmental Effects Profile for Antimony Oxides; p.58 (1985) EPA 600/x-85/271*

3 Rats were administered antimony trioxide. After single oral doses of 200 mg antimony trioxide in 5 ml of water, only 3.24% of the dose was eliminated in the urine. Levels in the feces were not measured. After administration of antimony trioxide in the diet at a concn of 2% for 8 months, antimony excretion in the feces was much greater than in the urine. [Peer Reviewed] *Gross P et al; Arch Ind Health 11: 473-78 (1955) as cited in USEPA; Health and Environmental Effects Profile for Antimony Oxides; p.46 (1985) EPA 600/x-85/271*

4 Trivalent antimony is concentrated in red blood cells and liver whereas the penta form is mostly in plasma. Both forms are excreted in feces and urine, but more trivalent antimony is excreted in urine whereas there is greater gastrointestinal excretion of pentavalent antimony /Trivalent and pentavalent antimony/ [Peer Reviewed] *Doull, J., C.D.Klassen, and M.D. Amdur (eds.). Casarett and Doull's Toxicology. 3rd ed., New York: Macmillan Co., Inc., 1986. 623*

5 Part of the intravenously admin antimony salts are absorbed by erythrocytes, and the rest is distributed to other tissues, predominantly the liver, adrenals, spleen, and thyroid. In rats, trivalent antimony is absorbed by erythrocytes, distributed to other tissues, and retained in the liver for a short time before it is gradually excreted in feces; pentavalent antimony remains in the plasma for a short time, and most of it is excreted in the urine, while a part is retained in the hair. In the livers of mice and humans, pentavalent antimony is reduced to the trivalent form. /Antimony salts/ [Peer Reviewed] *Venugopal, B. and T.D. Luckey. Metal Toxicity in Mammals, 2. New York: Plenum Press, 1978. 214*

6 ANTIMONY CMPD ... SLOWLY ABSORBED FROM GI TRACT. ... TRIVALENT CMPD HAVE HIGH AFFINITY FOR CELLS. ... THEY RAPIDLY LEAVE PLASMA BUT REMAIN IN CIRCULATION BOUND ... TO ERYTHROCYTES ... . /ANTIMONY(3+) CMPD/ [Peer Reviewed] *Gilman, A. G., L. S. Goodman, and A. Gilman. (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 6th ed. New York: Macmillan Publishing Co., Inc. 1980. 1028*

7 TRIVALENT ANTIMONIALS ARE EXCRETED ... BY KIDNEY, RENAL EXCRETION IS SLOW PRESUMABLY BECAUSE OF LOW PLASMA CONCN. THEREFORE, FOLLOWING SINGLE THERAPEUTIC DOSE ... ONLY ABOUT 10% IS RECOVERED IN URINE WITHIN 24 HR & ONLY ABOUT 30% WITHIN A WK. /TRIVALENT ANTIMONIALS/ [Peer Reviewed] *Gilman, A. G., L. S. Goodman, and A. Gilman. (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 6th ed. New York: Macmillan Publishing Co., Inc. 1980. 1028*

8 Certain inhaled antimony compounds appeared to be retained in the lung for long periods. /Antimony cmpd/ [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 31*

9 The lack of antimony accumulation in the tissues suggests a poorly defined homeostatic excretory mechanism. /Trivalent and pentavalent antimony/ [Peer Reviewed] *Venugopal, B. and T.D. Luckey. Metal Toxicity in Mammals, 2. New York: Plenum Press, 1978. 214*

10 The routes of excretion of parenterally administered antimony in the mouse, white rat,

10 The routes of excretion of parenterally administered antimony in the mouse, white rat, hamster, guinea pig, rabbit, dog, and human were reviewed. Trivalent antimony was excreted via the feces and urine. With the exception of the mouse, pentavalent antimony was excreted in the urine. While the percent of the dose excreted in the feces was less than 5% for all species tested, the % excreted in the urine was approximately 80, 60, 65, 70, 10, and 43% in the white rat, hamster, guinea pig, rabbit, dog, and human, respectively. /Trivalent and pentavalent antimony/ [Peer Reviewed] *Otto GF, Maren TH; Am J Hyg 51: 370-85 (1950) as cited in USEPA; Drinking Water Criteria Document for Antimony, EPA Contract No 68-03-3417, p.III-9 (1988)*

11 ANTIMONY MAY ENTER BODY ... THROUGH LUNG. FROM LUNG ... FREE ANTIMONY, IS ABSORBED & TAKEN UP BY BLOOD & TISSUES. /ANTIMONY AND CMPD/ [Peer Reviewed] *International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983. 177*

12 Environment and nutrition influence antimony concentrations of human tissues, causing large differences among individuals. Extremely high levels were found in the lung and bone tissues but not in liver or kidney of deceased antimony smelter workers. The lung contain the highest antimony levels of human tissues. The distribution of antimony is not homogeneous within organs or tissues. ... Great variations of antimony content were found in normal human platelets, serum albumin, and different tissues. /Antimony and cmpd/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 71*

13 Urine levels of antimony between 0.4 and 0.7 mg/l were measured in cases of workers with lung changes. /Antimony and cmpd/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 71*

Biological Half-Life:

Airborne factory dust (with a volume median diameter of 5.0 um and a geometric standard deviation of 2.1 um) from a Swedish copper smeltery contained antimony (Sb) (1.6 weight %) and arsenic (As) (19% weight %). The dust was neutron activated and intratracheally instilled in hamsters. In vivo measurements of lung clearance were undertaken of the radionuclides (76)As, (122)Sb, and (124)Sb. Two phases were recognized in the clearance curves. The approx half-time for the initial phase was about 40 hr for antimony trioxide, and 30 hr for antimony dust. The The second phase had an approx half-time of 20-40 days for antimony trioxide and antimony dust. The low solubility of antimony in factory dust combined with a long biological half-time may be of importance in explaining the observed lung accumulation of antimony in exposed workers. [Peer Reviewed] *Leffler P et al; Scand J Work Environ Health 10 (4): 245-51 (1984)*

Mechanism of Action:

1 ... The glutathione and nonprotein nitrogen content of blood, and the epinephrine content of the adrenals incr during chronic antimony toxicity in animals, suggesting incr protein catabolism. In vitro inhibition of succinate oxidase and pyruvate oxidase suggests interference by antimony with cellular respiratory metabolism by combination with sulfhydryl enzymes. The direct action on the heart muscle is owing to the combined effects of functional disorder of autonomic systems, caused by the inhibitory effect on the cerebral cortex and by hyperexcitability of the myocardium. /Antimony cmpd/ [Peer Reviewed] *Venugopal, B. and T.D. Luckey. Metal Toxicity in Mammals, 2. New York: Plenum Press, 1978. 216*

2 The ability of antimony and antimony containing parasiticidal agents to enhance the rate of heme degradation in liver and kidney was investigated. Trivalent antimony was shown to be an extremely potent inducer of heme oxygenase, the initial and rate limiting enzyme in heme degradation, in both organs, whereas pentavalent antimony was a weak inducer of this enzyme. The ability of antimony to induce heme oxygenase was dose dependent, independent of the salt used, and not a result of a direct activation of the enzyme in vitro. Concomitant with heme oxygenase induction by antimony, microsomal heme and

cytochrome p450 contents decreased. /Trivalent, pentavalent, antimony containing parasitical agent/ [Peer Reviewed] *Drummond GS, Kappas A; J Exp Med 153 (2): 245-6 (1981)*

3 Trivalent antimonials inhibit phosphofructokinase in schistosomes. This enzyme catalyzes the rate-limiting step in the glycolytic pathway. The inhibition of phosphofructokinase activity can be reversed by increasing the concn of fructose-6-phosphate & removing the antimony from the supporting medium. This reversibility manifests itself during treatment of the host with subcurative doses of antimonials. Initially the schistosomes migrate from mesenteric veins to liver, & egg production ceases. After termination of treatment ... the worms eventually recover & shift back to the mesenteric veins. Mammalian phosphofructokinase is much less sensitive (nearly 100 fold) to the action of antimonials ... therefore, the chemotherapeutic usefulness of antimonials in schistosomiasis is due, in part at least, to differences in the nature of these two enzymes. /Trivalent antimonials/ [Peer Reviewed] *Gilman, A. G., L. S. Goodman, and A. Gilman. (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 6th ed. New York: Macmillan Publishing Co., Inc. 1980. 1028*

Interactions:

WHEN THYROXIN WAS GIVEN WITH ANTIMONY TRIOXIDE, MARKED LOSS IN BODY WEIGHT GAIN OCCURRED WITH INCREASE IN OXYGEN UPTAKE; THE RELATIVE DISTRIBUTION OF ANTIMONY IN THE TISSUES WAS INCREASED SLIGHTLY OVER THAT OF ANTIMONY ALONE. [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 1512*

7.0 ENVIRONMENTAL FATE/EXPOSURE POTENTIAL

POLLUTION SOURCES

Natural Occurring Sources:

1 OCCURS IN NATURE AS VALENTINITE. [Peer Reviewed] *Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 91*

2 Antimony occurs in the earth's crust as about 2X10-1 to 10X10-1 mg/kg and in seawater at about 2X10-4 mg/kg. It is found mainly as sulfides and oxides, sometimes as native metal. ... About 114 minerals containing antimony are known. [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 67*

3 Other common ores containing antimony are cervantite, valentinite, livingstonite, jamisonite, and kermesite. [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 27*

4 ... MORE THAN ONE HUNDRED MINERALS CONTAIN ANTIMONY, COMMERCIAL ORES ARE LIMITED TO ... CHIEFLY OXIDES, SULFIDES, & COMPLEX COPPER, LEAD, GOLD, AND MERCURY. ANTIMONY SULFIDES, THE MOST IMPORTANT OF WHICH IS STIBNITE (SB2S3). /ANTIMONY OXIDES AND SULFIDES/ [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 1506*

5 Concentrations of antimony range from 0.5-5 ppm in coal and 30-107 ppm in petroleum. /Total antimony/ [Peer Reviewed] *Brown, K.W., G. B. Evans, Jr., B.D. Frentrup (eds.). Hazardous Waste Land Treatment. Boston, MA: Butterworth Publishers, 1983. 237*

Artificial Sources:

1 Substantial amounts of antimony trioxide ... are released to the atmosphere during processing of antimony materials including smelting of ores, molding and incineration of

processing of antimony materials including smelting of ores, molding and incineration of products, as well as the combustion of fossil fuels which are utilize the high temperatures needed to volatilize antimony trioxide. [Peer Reviewed] *Newman JR et al; Environmental Assessment for Antimony, Antimony Oxides and Antimony Sulfides (1981) as cited in USEPA; Health and Enviromental Effects Profile for Antimony Oxides; p.7 (1985) EPA 600/x-85/271*

2 Industrial dust and exhaust gases of cars and oil fuels are the main sources of antimony in urban air. /Antimony cmpd/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.) Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 69*

ENVIRONMENTAL FATE

1 Antimony is expected to exist as the trioxide in the atmosphere, since most of the atmospheric releases of antimony substances result from high temperature industrial processes, from the combustion of petroleum, petroleum products and coal, and from the incineraton of products that contain antimony. At the high temperatures used in these processes, oxidation of the antimony substances occurs, resulting in the formation of antimony trioxide (and possibly also antimony tetraoxide and antimony pentoxide). [Peer Reviewed] *USEPA; Health and Environmental Effects Profile for Antimony Oxides (1985) as cited in USEPA; Health Effects Assessment for Antimony and Compounds p.1 (1987) EPA 600/8-88/018*

2 ELEMENTAL CONCN IN CALCAREOUS SHELLS, BOTH ARAGONITIC & MIXED ARAGONITIC-CALCITIC, ARE SIMILAR & MAY REFLECT THE COMPOSITION OF THE WATERS IN WHICH THEY LIVED. ... WITH 20-25 MOLTS/SHRIMP/YR, THE MOLTING OF SHRIMP CAN CAUSE A REDISTRIBUTION OF THESE ELEMENTS WITHIN THE MARINE ENVIRONMENT. /ANTIMONY CMPD/ [Peer Reviewed] *BERTINE KK; GOLDBERG ED; LIMNOL OCEANOGR 17 (6): 877-84 (1972)*

ENVIRONMENTAL TRANSFORMATIONS

Biodegradation:

Pure cultural study using Stibiobacter senarmontii, an autotrophic bacterium isolated from antimony ore samples, demonstrated that biological transformation of antimony oxides in the environment could be possible. The bacteria were grown in a mineral medium containing antimony trioxide and oxidized the chemical (antimony trioxide) at rates of 45.5-51.6 mg/month for senarmonite (cubic) and 13.5-19.3 mg/month for valentinite (rhombic). Little antimony trioxide oxidation occured in the sterile medium. [Peer Reviewed] *Lyalikova NM; Microbiology 43: 799-805 (1974) as cited in USEPA; Health and Environmental Effects Profile for Antimony Oxides; p.21 (1985) EPA 600/x-85/271*

ENVIRONMENTAL TRANSPORT

Bioconcentration:

COMPOSITIONAL CHANGES IN TRACE ELEMENT CONTENT OF SHELLS OF MUSSELS & CLAMS THAT MIGHT BE RELATED TO MAN'S INFLUENCE ON COMPOSITION OF INSHORE MARINE WATERS WERE SOUGHT. FRESHLY CAUGHT & MUSEUM SPECIMENS WERE ANALYZED FOR ELEMENTS INCLUDING ANTIMONY. ... THE PROTEINACEOUS MOLTS OF SHRIMP CONTAINED HIGH LEVELS OF THESE ELEMENTS. /ANTIMONY CMPD/ [Peer Reviewed] *BERTINE KK; GOLDBERG ED; LIMNOL OCEANOGR 17 (6): 877-84 (1972)*

Volatilization from Soil/Water:

Loss of antimony oxides from water through volatilization is very unlikely under normal environmental conditions due to their very low concn and the the low concn of their hydrolysis products, and also due to their polarity and extremely low vapor pressures. /Antimony oxides/ [Peer Reviewed] *USEPA; Health and Environmental Effects Profile for Antimony Oxides; p.21 (1985) EPA 600/x-85/271*

ENVIRONMENTAL CONCENTRATIONS

Water Concentrations:

1 In the river Rhine, antimony averages 0.1 ug/l. A level of 0.2 ug/l has been reported from the northeastern Pacific Ocean. /Total antimony/ [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 29*

2 SEAWATER: CONCENTRATION OF STABLE ANTIMONY IN NORTH ADRIATIC COASTAL WATERS (YUGOSLAVIA) WAS INVESTIGATED BY NEUTRON ACTIVATION TECHNIQUE. THE FOLLOWING CONCENTRATIONS WERE OBTAINED: 0.31 UG ANTIMONY/CU DM FOR FILTERED SEA WATER, AND 45 UG ANTIMONY/CU DM FOR NON-FILTERED SEA WATER. /TOTAL ANTIMONY/ [Peer Reviewed] *STROHAL P ET AL, ESTUARINE COASTAL MAR SCI 3 (2): 119-24 (1975)*

Sediment/Soil Concentrations:

1 In soil, antimony usually ranges from 0.1 to 10 mg/kg dry weight. /Total antimony/ [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 29*

2 Sludges used for manuring soils in Indiana (USA) or collected near Vienna (Austria) from the Danube River contained antimony concentrations between 4 and 22 mg/kg dried sample. /Total antimony/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 69*

3 ... The average range of antimony in dry soils is 2-10 ppm. /Total antimony/ [Peer Reviewed] *Brown, K.W., G. B. Evans, Jr., B.D. Frentrup (eds.). Hazardous Waste Land Treatment. Boston, MA: Butterworth Publishers, 1983. 237*

Atmospheric Concentrations:

1 Antimony trioxide has been detected in high concn (>300 ppm) downwind from a copper smelting plant. [Peer Reviewed] *Crecelius EA et al; Sci and Technol 9 (4): 325-33 (1975) as cited in USEPA; Health and Environmental Effects Profile for Antimony Oxides p.12 (1985) EPA 600/x-85/271*

2 ... In Chicago concentrations of antimony in air ranging from 1.4 to 55 ng/cu m and an average of 32 ng/cu m, respectively /have been reported/. Somewhat lower levels (0.4 to 4 ng/cu m) were reported from 7 different sites in the United Kingdom. /Total antimony/ [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 29*

3 ... Urban air contains 0.05-0.06 ppm antimony. /Total antimony/ [Peer Reviewed] *Brown, K.W., G. B. Evans, Jr., B.D. Frentrup (eds.). Hazardous Waste Land Treatment. Boston, MA: Butterworth Publishers, 1983. 237*

4 FOLLOWING THE INSTALLATION OF AIR POLLUTION CONTROL DEVICES ON ANTIMONY SMELTERS, ONLY A TRACE AMOUNT OF ANTIMONY PASSES THROUGH THE FILTER-SCRUBBER. /TOTAL ANTIMONY/ [Peer Reviewed] *YOSHIKAWA K ET AL; SHIGA-KEN KANKYO SENTA SHOHO 93-102 (1977)*

Food Survey Values:

Levels of 3 and 8 ug/kg /of antimony/ have been found in milk and potato powder. /Total antimony/ [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 28*

Plant Concentrations:

The average concentration of antimony in plants is 0.06 ppm ... . /Total antimony/ [Peer Reviewed] *Brown, K.W., G. B. Evans, Jr., B.D. Frentrup (eds.). Hazardous Waste Land Treatment. Boston, MA: Butterworth Publishers, 1983. 237*

Fish/Seafood Concentrations:

1 It could not be detected in fishes of the Danube River. /Total antimony/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 69*

2 In freshwater fish, antimony concentrations have been reported to be in the order of 3 ug/kg wet weight. /Total antimony/ [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 28*

Milk Concentrations:

The concentrations of antimony and other elements in human milk obtained from subjects in Italy. More than 130 samples were obtained from 21 women for about 2 to 3 months starting 15 days after childbirth. A mean + or - standard deviation of 3.0 + or - 0.4 ng antimony/g of milk (wet basis) was reported for 49 samples of milk obtained from 16 women with antimony levels above the detection limit of 0.05 ng antimony/g. Antimony values ranged from less than 0.05 to 12.9 ng/g among the 21 subjects. /Total antimony/ [Peer Reviewed] *Clemente GF et al; Sci Total Environ 24: 255-65 (1982) as cited in USEPA; Drinking Water Criteria Document for Antimony, EPA Contract No 68-03-3417 p.III-19 (1988)*

Other Environmental Concentrations:

Antimony in cigarettes has been studied by means of neutron activation. ... The tobacco, on an average, contained 0.1 mg antimony/kg dry weight. The amount of inhaled antimony was estimated to be 20% of the total amount of antimony in one cigarette. /Total antimony/ [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 29*

HUMAN EXPOSURE

Probable Routes of Human Exposure:

1 Acute antimony poisoning can occur from ... exposure in industrial operations and from contamination of food containers. /Antimony and cmpd/ [Peer Reviewed] *Venugopal, B. and T.D. Luckey. Metal Toxicity in Mammals, 2. New York: Plenum Press, 1978. 213*

2 Antimony migrates only in traces from pottery into drinks. /Antimony and cmpd/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 69*

3 ... /Workers in/ a plant manufacturing antimony trioxide. ... /may come/ into contact with both dust and fumes ... . [Peer Reviewed] *Browning, E. Toxicity of Industrial Metals. 2nd ed. New York: Appleton-Century-Crofts, 1969. 33*

York: Appleton-Century-Crofts, 1969. 33

4 HAZARDOUS EXPOSURES HAVE BEEN REPORTED IN MINERS OF ANTIMONY ORE IN SOME PARTS OF THE WORLD. ... EXPOSURES IN THE PAST (UP TO 1960) IN MINING, CONCENTRATING AND SMELTING HAVE BEEN COMPLICATED BY THE PRESENCE OF VERY CONSIDERABLE AMOUNTS OF ARSENIC AND SULFUR DIOXIDE MIXED WITH COPPER, LEAD AND SELENIUM, A CONDITION NO LONGER EXISTING IN PRESENT DAY REFINERIES. WITH REGARD TO HEALTH HAZARD EVALUATION OF ANTIMONY EXPOSURES, A CLEAR DISTINCTION SHOULD BE MADE BETWEEN HAZARDS FROM EXPOSURES IN SMELTING AND REFINING AND THOSE IN HANDLING AND USE OF THE PRODUCT. ... IN ANOTHER CLASS OF EXPOSURES, ANTIMONY ALLOYS, FOUNDRY WORKERS, AND TYPESETTERS MAY BE EXPOSED TO ANTIMONY FUMES, AND RUBBER COMPOUNDERS MAY SUFFER EXPOSURE TO ANTIMONY COMPOUNDS. /ANTIMONY CMPD/ [Peer Reviewed] *Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 1506*

5 Antimony process workers run the highest risk to inhale antimonials. /Total antimony/ [Peer Reviewed] *Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988. 69*

Body Burdens:

1 The concentrations of antimony and other elements in human milk obtained from subjects in Italy. More than 130 samples were obtained from 21 women for about 2 to 3 months starting 15 days after childbirth. A mean + or - standard deviation of 3.0 + or - 0.4 ng antimony/g of milk (wet basis) was reported for 49 samples of milk obtained from 16 women with antimony levels above the detection limit of 0.05 ng antimony/g. Antimony values ranged from less than 0.05 to 12.9 ng/g among the 21 subjects. /Total antimony/ [Peer Reviewed] *Clemente GF et al; Sci Total Environ 24: 255-65 (1982) as cited in USEPA; Drinking Water Criteria Document for Antimony, EPA Contract No 68-03-3417 p.III-19 (1988)*

2 A group of 109 male workers occupationally exposed to both antimony (as Sb2O3) and lead in the glass-producing industry were examined for levels of these metals in whole blood and urine. The workers were divided into four groups based on specific work activities: melter (n= 32), batch mixer (n= 45), craftsman (n= 8), and glass washer (n= 24). Blood and urine samples were collected at the end of a shift. Blood Sb values ranged from 0.4 to 3.1 ug/l with a median value of 1.0 ug/l. The median blood Sb values of the glass washers (1.1 ug/l) and batch mixers (1.1 ug/l) were significantly higher than that of the craftsmen (0.7 ug/l). The melters (0.8 ug/l) were not significantly different from any other group. The median value of 51 unexposed controls was 0.6 ug/l. Concentrations of Sb in the urine were between 0.2 and 15.7 ug/l (median 1.9 ug/l). The median concentration of Sb in the urine of batch mixers (5.0 ug/l) was significantly different when compared to melters, craftsmen, glass washers, and unexposed controls (0.9, 0.9, 1.2, and 0.4 ug/l, respectively). Concentrations of airborne Sb2O3 as measured by personal samplers were highest in the batch bunkers, ranging from <50 up to 840 ug/cu m (n= 3). Concentrations in the melting area were <50 ug/cu m (n= 3). Since only two personal air samplers were working above the detection limit of 50 ug Sb2O3/cu m, a correlation between exposure and urinary concentrations of Sb could not be made. Airborne concentrations as measured by stationary samplers were < or = 5 in the melting area (n= 3) and 40 to 290 ug/cu m in the batch bunker (n= 4). The detection limit of stationary samplers was 5 ug/cu m. No relationship between smoking habits and blood or urinary concentrations of Sb were found. [Peer Reviewed] *Ludersdorf R et al; Int Arch Occupational Environmental Health 59 (5): 469-74 (1987)*

8.0 EXPOSURE STANDARDS AND REGULATIONS

STANDARDS AND REGULATIONS

Immediately Dangerous to Life or Health: 80 mg/cu m /Antimony & cmpd (as Sb)/ [QC Reviewed] *NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS(NIOSH) Publication No. 90-117. Washington, DC: U.S. Government Printing Office, June 1990 40*

OCCUPATIONAL PERMISSIBLE LEVELS

OSHA Standards:

8 hr Time-Weighted avg: 0.5 mg/cu m /Antimony and compounds/ [Peer Reviewed] *29 CFR 1910.1000 (7/1/88)*

NIOSH Recommendations: 10 hr Time-Weighted avg: 0.5 mg/cu m /Antimony and cmpd/ [Peer Reviewed] *NIOSH. Pocket Guide to Chemical Hazards. 2nd Printing. DHHS (NIOSH) Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services, NIOSH/Supt.of Documents, GPO, February 1987. 52*

Threshold Limit Values:

1 A2. A2= Suspected human carcinogen. (1980) /Antimony trioxide production/ [QC Reviewed] *American Conference of Governmental Industrial Hygienists. Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and BiologicalExposure Indices (BEIs) for 1995-1996. Cincinnati, OH: ACGIH, 1995. 13*

2 Excursion Limit Recommendation: Excursions in worker exposure levels may exceed three times the TLV-TWA for no more than a total of 30 min during a work day, and under no circumstances should they exceed five times the TLV-TWA, provided that the TLV-TWA is not exceeded. /Antimony trioxide handling and use, as Sb/ [QC Reviewed] *American Conference of Governmental Industrial Hygienists. Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and BiologicalExposure Indices (BEIs) for 1995-1996. Cincinnati, OH: ACGIH, 1995. 5*

Other Occupational Permissible Levels:

MAC: 1 mg/cu m (USSR) [Peer Reviewed] *International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office. 1983. 177*

OTHER STANDARDS AND REGULATIONS

Federal Drinking Water Standards: EPA 6 ug/l /Antimony/ *USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)*

State Drinking Water Guidelines:

1 (AZ) ARIZONA 14 ug/l /Antimony/ *USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)*

2 (MN) MINNESOTA 20 ug/l /Antimony/ *USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)*

Clean Water Act Requirements:

1 Designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. *40 CFR 116.4 (7/1/88)*

2 Toxic pollutant designated pursuant to section 307(a)(1) of the Clean Water Act and is subject to effluent limitations. /Antimony and compounds/ *40 CFR 401.15 (7/1/88)*

2

subject to effluent limitations. /Antimony and compounds/ *40 CFR 401.15 (7/1/88)*

CERCLA Reportable Quantities:

Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of this designated hazardous substance, in an amount equal to or greater than its reportable quantity of 1000 lb or 454 kg. The toll free number of the NRC is (800) 424-8802; In the Washington D.C. metropolitan area (202) 426-2675. The rule for determining when notification is required is stated in 40 CFR 302.4 (section IV. D.3.b). [Peer Reviewed] *40 CFR 302.4 (7/1/88)*

TSCA Requirements:

1 Pursuant to section 8(d) of TSCA, EPA promulgated a model Health and Safety Data Reporting Rule. The section 8(d) model rule requires manufacturers, importers, and processors of listed chemical substances and mixtures to submit to EPA copies and lists of unpublished health and safety studies. Antimony trioxide is included on this list. [Peer Reviewed] *40 CFR 712.30 (7/1/88)*

2 Section 8(a) of TSCA requires manufacturers of this chemical substance to report preliminary assessment information concerned with production, use, and exposure to EPA as cited in the preamble of the 51 FR 41329. [Peer Reviewed] *40 CFR 712.30 (7/1/88)*

FDA Requirements:

Antimony oxide is an indirect food additive for use only as a component of adhesives. [Peer Reviewed] *21 CFR 175.105 (4/1/88)*

9.0 MONITORING AND ANALYSIS METHODS

Sampling Procedures:

Losses due to volatilization of antimony from samples in connection with wet or dry ashing constitute a particular problem that should be considered when biological samples are digested prior to atomic absorption spectrophotometry. /Antimony and antimony cmpd/ [Peer Reviewed] *Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986.,p. V2 27*

Analytical Laboratory Methods:

1 IN AIR SAMPLES USING COLORIMETRY & ATOMIC ABSORPTION. TEN NIOSH ANALYTICAL METHODS, SET- 2, USA NTIS, PB REP, ISS PB-271464, 1977, 316 PAGES. /TOTAL ANTIMONY/ [Peer Reviewed] *ELLER PM, HAARTZ JC; AM IND HYG ASSOC J 39 (10): 790-800 (1978)*

2 EPA Method 7040: Antimony (Atomic Absorption, Direct Aspiration). Method 7040 is applicable for the determination of metals in solution by atomic absorption spectrometry. Preliminary treatment of waste water, ground water, extraction procedure (EP) extracts, and industrial waste is always necessary because of the complexity and variability of sample matrix. After aspiration and atomization of the sample in a flame, a light beam from a hollow cathode lamp or an electrodeless discharge lamp is directed through the flame into a monochromator and onto a detector that measures the amount of light absorbed. ... The light energy absorbed by the flame is a measure of the concentration of that metal in the sample. The performance characteristics for an aqueous sample free of the interferences avg: optimum concentration range of 1-40 mg/l with a wavelength of 217.6 nm, a sensitivity of 0.5 mg/l, and a detection limit of 0.02 mg/l. /Total antimony/ [Peer Reviewed] *USEPA; Test Methods for Evaluating Solid Waste SW-846 (1986)*

3 EPA Method 7041: Antimony (Atomic Absorption, Furnace Technique). Method 7041 is applicable for the determination of metals in solution by atomic absorption spectrometry. For

applicable for the determination of metals in solution by atomic absorption spectrometry. For certain samples, lower concentrations may be determined using this technique. To ensure valid data, each matrix must be examined for interference effects, and if detected, treat them accordingly, using either successive dilution, matrix modification, or methods of standard additions. If poor recoveries are obtained, a matrix modifier may be necessary. A representative aliquot of a sample is placed in the graphite tube in the furnace, evaporated to dryness, charred, and atomized. ... Radiation from a given excited element is passed through the vapor containing ground state atoms of that element. ... The metal atoms to be measured are placed in the beam of radiation by increasing the temperature of the furnace, thereby causing the injected specimen to be volatilized. A monochromator isolates the characteristic radiation from the hollow cathode lamp or electrodeless discharge lamp, and a photosensitive device measures the attenuated transmitted radiation. The optimum concentration range is 20-300 ug/l. /Total antimony/ [Peer Reviewed] *USEPA; Test Methods for Evaluating Solid Waste SW-846 (1986)*

4 Method 304: Electrothermal Atomization Atomic Absorption Spectrometry for the determination of micro quantities of selected elements including antimony in water and wastewater samples. Using an electrically heated atomizer or graphite furnace, at a wavelength of 217.6 nm, the estimated detection limit is 3 ug/l at an optimum concentration range of 20-300 ug/l. These values may vary with the chemical form of the antimony being determined, sample composition, or instrumental conditions. /Total antimony (from table)/ [Peer Reviewed] *Franson MA (Ed); Standard Methods for the Examination of Water and Wastewater p.174 (1985)*

5 USE OF FLUOROMETRY TO DETERMINE SUBMICROGRAM QUANTITIES OF ANTIMONY IS PRESENTED. /TOTAL ANTIMONY/ [Peer Reviewed] *FILER TD; ANAL CHEM 43 (6): 725-9 (1971)*

6 DETERMINATION OF ANTIMONY IN FOODS VIA RAPID HYDRIDE EVOLUTION & ATOMIC ABSORPTION SPECTROMETRY. /TOTAL ANTIMONY/ [Peer Reviewed] *FIORINO JA ET AL; ANAL CHEM 48 (1): 120-5 (1976)*

7 ANALYSIS OF ANTIMONY IN AIR VIA HYDRIDE GENERATION & ATOMIC ABSORPTION SPECTROSCOPY IN AIR IS DESCRIBED. /TOTAL ANTIMONY/ [Peer Reviewed] *CORP SOC; HEALTH LAB SCI 14 (1): 53-8 (1977)*

8 A PROCEDURE USING ATOMIC ABSORPTION SPECTROPHOTOMETRY VIA EVOLUTION OF THE CORRESPONDING HYDRIDE BY SODIUM BOROHYDRIDE IS PRESENTED. /TOTAL ANTIMONY/ [Peer Reviewed] *KAN K-T; ANAL LETT 6 (7): 603-11 (1973)*

9 THE DETERMINATION OF TRACE METALS /INCLUDING ANTIMONY/ IN EFFLUENTS BY DIFFERENTIAL PULSE ANODIC STRIPPING VOLTAMMETRY IS DISCUSSED. /TOTAL ANTIMONY/ [Peer Reviewed] *KINARD JT; US NTIS, PB REP; PB-272258: 50 (1977)*

Clinical Laboratory Methods:

1 NIOSH 8005: Analyte: antimony; Specimen: blood or tissue; Vol: 10 ml (blood) or 1 g (tissue); Preservative: heparin (blood); none for tissue; Stability: not established; Technique: inductively-coupled argon plasma-atomic emission spectroscopy; Wavelength: 217.58 nm; Range: 10-10,000 ug/ 100 g blood, 2-2000 ug/g tissue; Est LOD: 1 ug/100 g blood, 0.2 ug/g tissue; Precision (% Sr): 4.9 Interferences: spectral, minimized by wavelength selection and interelement correction. /Total antimony/ [Peer Reviewed] *U.S. Department of Health and Human Services, Public Health Service. Centers for Disease Control, National Institute for Occupational Safety and Health. NIOSHManual of Analytical Methods, 3rd ed. Volumes 1 and 2 with 1985 supplement, and revisions. Washi*

2 IN BIOLOGICAL SAMPLES USING COLORIMETRY & ATOMIC ABSORPTION. TEN NIOSH ANALYTICAL METHODS, SET- 2, US NTIS, PB REP, ISS PB-271464, 1977, 316 PAGES. /TOTAL ANTIMONY/ [Peer Reviewed] *ELLER PM, HAARTZ JC; AM IND HYG ASSOC J 39 (10): 790-800 (1978)*

3 Reinsch Test: Method: Qualitative: copper strip or copper spiral. Specimens and special requirements: urine, vomitus, gastric lavage. Collect in metal-free container. Specimen preparation depends upon particular modification of Reinsch test. If 100 ml urine and 10 ml

preparation depends upon particular modification of Reinsch test. If 100 ml urine and 10 ml concentrated hydrochloric acid are used, rule out arsenic, mercury, or selenium. Gray-to black deposit /on copper strip/: positive for ... antimony. Purplish sheen suggests presence of antimony. Interferences: none found. /Total antimony/ [Peer Reviewed] *Tietz, N.W. (ed.). Clinical Guide to Laboratory Tests. Philadelphia, PA: W.B. Saunders Co., 1983. 426*

4 IN BLOOD & URINE. DETERMINATION OF ANTIMONY BY STIBINE GENERATION AND ATOMIC ABSORPTION SPECTROPHOTOMETRY USING FLAME HEATED SILICA FURNACE. /TOTAL ANTIMONY/ [Peer Reviewed] *COLLETT DL ET AL; ANALYST (LONDON) 103 (1231): 1074-5 (1978)*

5 /ANTIMONY IS ONE OF THE HEAVY METALS ANALYZED BY THE/ USE OF DIFFERENTIAL PULSE ANODIC STRIPPING VOLTAMMETRY AS A RAPID SCREENING TECHNIQUE FOR HEAVY METAL INTOXICATION. /TOTAL ANTIMONY/ [Peer Reviewed] *FRANKE JP, DE ZEEUW RA; ARCH TOXICOL 37 (1): 47-55 (1976)*

6 X-RAY SPECTROPHOTOMETRIC METHOD USING A SILICON LITHIUM DRIFTED DETECTOR FOR DETERMINING IN VIVO THE ANTIMONY DEPOSITED IN THE LUNG IS DISCUSSED. /TOTAL ANTIMONY/ [Peer Reviewed] *BLOCH P; RADIOLOGY 94 (1): 200 (1970)*

7 NEUTRON ACTIVATION ANALYSIS WAS USED TO ANALYZE DISEASED & NORMAL LUNG TISSUE FOR TRACE AMOUNTS OF ANTIMONY. /TOTAL ANTIMONY/ [Peer Reviewed] *KENNEDY JH; AM J MED SCI 251 (1): 37-9 (1966)*

8 ANALYSIS OF ANTIMONY IN URINE VIA HYDRIDE GENERATION & ATOMIC ABSORPTION SPECTROSCOPY. /TOTAL ANTIMONY/ [Peer Reviewed] *CORP SOC; HEALTH LAB SCI 14 (1): 53-8 (1977)*

9 SPECTROPHOTOMETRICAL DETERMINATION OF ANTIMONY IN URINE IS DESCRIBED. /TOTAL ANTIMONY/ [Peer Reviewed] *KNEIP TJ; HEALTH LAB SCI 13 (1): 90-4 (1976)*

10 ANALYSIS OF TOXIC METALS /INCLUDING ANTIMONY/ IN URINE BY ANODIC STRIPPING VOLTAMMETRY. /TOTAL ANTIMONY/ [Peer Reviewed] *FRANKE JP, DE ZEEUW RA; DEV TOXICOL ENVIRON SCI 1 (CLIN CHEM CHEM TOXICOL MEET, PROC INT SYMP): 371-4 (1977)*

10.0 ADDITIONAL REFERENCES

Special Reports:

1 TSCA CHIPs present a preliminary assessment of antimony trioxide's potential for injury to human health & the environment (available at EPA's TSCA Assistance Office: (202) 554-1404

2 USEPA; Health Effects Assessment for Antimony and Compounds (1987) EPA 600/8-88/018

3 USEPA; Health and Environmental Effects Profile for Antimony Oxides (1985) EPA 600/x-85/271

4 USEPA; Drinking Water Criteria Document for Antimony (1988) EPAContract No 68-03-3417

5 USEPA; Ambient Water Quality Criteria for Antimony (1980) EPA 400/5-80/020

6 NIOSH; Criteria for a Recommended Standard ... Occupational Exposure to Antimony (1978) Publication No 78-216

7 DHHS/ATSDR; Toxicological Profile for Antimony TP-91-02 (1992)

Antimony trioxide

IRIS - Integrated Risk Information System

0676 Antimony trioxide; CASRN 1309-64-4 (10/01/97)

Health assessment information on a chemical substance is included in IRIS only after a comprehensive review of chronic toxicity data by U.S. EPA health scientists from several Program Offices and the Office of Research and Development. The summaries presented in Sections I and II represent a consensus reached in the review process. Background information and explanations of the methods used to derive the values given in IRIS are provided in the Background Documents.

STATUS OF DATA FOR Antimony trioxide

File On-Line 09/01/95

Category (section)	Status	Last Revised
Oral RfD Assessment (I.A.)	no data	
Inhalation RfC Assessment (I.B.)	on-line	09/01/95
Carcinogenicity Assessment (II.)	no data	

I. CHRONIC HEALTH HAZARD ASSESSMENTS FOR NONCARCINOGENIC EFFECTS

I.A. REFERENCE DOSE FOR CHRONIC ORAL EXPOSURE (RfD)

Substance Name -- Antimony trioxide
CASRN -- 1309-64-4
Not available at this time.

I.B. REFERENCE CONCENTRATION FOR CHRONIC INHALATION EXPOSURE (RfC)

Substance Name -- Antimony trioxide
CASRN -- 1309-64-4
Last Revised -- 09/01/95
The inhalation Reference Concentration (RfC) is analogous to the oral RfD and is likewise based on the assumption that thresholds exist for certain toxic effects such as cellular necrosis. The inhalation RfC considers toxic effects for both the respiratory system (portal-of-entry) and for effects peripheral to the respiratory system (extrarespiratory effects). It is expressed in units of mg/cu.m. In general, the RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. Inhalation RfCs were derived according to the Interim Methods for Development of Inhalation Reference Doses (EPA/600/8-88/066F August 1989) and subsequently, according to Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry (EPA/600/8-90/066F October 1994). RfCs can also be derived for the noncarcinogenic health effects of substances that are carcinogens. Therefore, it is essential to refer to other sources of information concerning the carcinogenicity of this substance. If the U.S. EPA has evaluated this substance for potential human carcinogenicity, a summary of that evaluation will be contained in

Section II of this file.

NOTE: ****SEE BENCHMARK CONCENTRATION IN DISCUSSION. Discussion of the benchmark dose can be found in the Discussion of Principal and Supporting Studies Section.

I.B.1. INHALATION RfC SUMMARY

Critical Effect	Exposures*	UF	MF	RfC
Pulmonary toxicity, chronic interstitial inflammation Rat 1-Year Inhalation Toxicity Study	Benchmark Concentration: See Conversion Factors and Assumptions and Principal and Supporting Studies	300	1	2E-4 mg/cu.m

Newton et al., 1994

*Conversion Factors and Assumptions: MW = 169.8. BMC = 0.87 mg/cu.m. BMC(ADJ) = 0.87 +/- 6 hours/24 hours +/- 5 days/7 days = 0.16 mg/cu.m. The BMC10(HEC) was calculated for a particle:respiratory effect in the thoracic region. The RDDR(TH) = 0.46 for MMAD = 3.7 microns and sigma g = 1.7, based on dosimetric modeling as described in U.S. EPA, 1994. BMC10(HEC) = BMC10(ADJ) x RDDR = 0.074 mg/cu.m

I.B.2. PRINCIPAL AND SUPPORTING STUDIES (INHALATION RfC)

Newton, P.E., H.F. Bolte, I.W. Daly, et al. 1994. Subchronic and chronic inhalation toxicity of antimony trioxide in the rat. Fund. Appl. Toxicol. 22: 561-576.

Newton et al. (1994) conducted a chronic study in which groups of 65 Fischer 344 rats/sex/group were exposed to target concentrations of 0, 0.05, 0.50, or 5.00 mg/cu.m (actual concentrations measured by atomic absorption were 0, 0.06, 0.51, or 4.50 mg/cu.m, respectively) antimony trioxide for 6 hours/day, 5 days/week for 1 year (duration-adjusted concentrations = 0, 0.01, 0.09, or 0.80 mg/cu.m, respectively). The article by Newton et al. (1994) is the published version of an earlier, more complete report (Bio/dynamics, 1990). In addition to the 1-year exposure, some animals were held for a 1-year recovery period. Interim sacrifices were conducted on 5 animals/sex/group at 6 and 12 months of exposure and at the end of the first 6 months of the 12- month postexposure recovery period. The remainder of the animals were sacrificed at the end of the 12-month recovery period. The antimony trioxide was determined to be 99.68% pure. The rats were exposed (whole body) in 6 cu.m stainless steel and glass chambers with a calculated air flow of 2,077- 2,280 L/min. The test atmosphere was generated with a Fluidized Bed Generator (TSI, Inc., Model 3400 or 9310). The test atmosphere was analyzed by atomic absorption spectrometry. Particle size distribution measurements were made once at the beginning of weeks 4, 8, and 13, and months 6 and 12 using a TSI Aerodynamic Particle Sizer. The particle size distribution at the high concentration also was analyzed using a Delron DCI-6 (Battelle) cascade impactor for comparative purposes. The MMAD was 3.7 microns, and sigma g was 1.7 for all concentrations. Body weights were measured weekly during the first 3 months of exposure and monthly thereafter; hematology analyses were conducted on 5 animals/sex/group at 12 and 18 months and on 10 rats/sex/group at 24 months. Gross and histopathological evaluations were performed on all animals. Microscopic examinations were performed on tissues of the larynx (1 section), lymph node [4 sections (peribronchial)], lungs (1 section from each lung and 1 from the main stem bronchi), trachea (1 section), nasal turbinates (4 sections), and heart for animals in all groups. The eyes, kidneys, liver, prostrate, spleen, and urinary bladder were examined in the control and high- exposure groups.

No difference between the control and exposed groups was noted in survival, although an unexplained increase in the number of deaths was noted in weeks 49-53. Body weight was not affected by exposure to antimony trioxide.

No significant changes in hematological parameters were observed that were concentration-related or consistent across time periods. However, an increase in mean corpuscular hemoglobin concentration was seen in both across time periods. However, an increase in mean corpuscular hemoglobin concentration was seen in both sexes exposed to the high concentration for 12 months. This effect was not noted at other exposure intervals.

An ophthalmoscopic examination was performed on all rats before the test and at 6, 12, 18, and 24 months. Mild, compound-related ocular irritation was noted at 6 months, but no indications of compound-related ocular disease were noted at 12 or 18 months. Examination of all surviving rats at 24 months revealed increases in the incidence of conjunctivitis (reported as chromodacryorrhea secondary to dental abnormality, infectious disease, or xerosis) and cataracts (females only; principally posterior subcapsular cataracts). Statistical analysis of the cataract response observed at 24 months was performed for both male and female rats (Allen and Chapman, 1993). Trend test and pairwise comparisons (Fishers Exact Test) revealed no concentration-response relationship for the male rats. Incidence in the females was 3/28, 8/21, 12/34, and 14/32 for the control and 0.06-, 0.51- and 4.50-mg/cu.m groups, respectively. Pairwise comparisons (Fishers Exact Test) suggest marginally significant increases over controls ($p < 0.05$) in the low- and mid-concentration groups (p values were between 0.03 and 0.04). When just those two concentration groups and the controls were included in a trend test analysis, the increases were determined not to be statistically significant (p value was 0.09). At the high concentration, however, a statistically significant increase in female cataracts was indicated by both the trend and pairwise tests ($p < 0.01$). Based on information provided by the principal investigators, this effect is not likely to be due to lack of cage rotation (resulting in unequal exposure to light among the groups). However, occupational studies that involved physical examinations and reported respiratory effects in workers exposed to antimony trioxide have not reported significant eye effects (Potkonjak and Pavlovich, 1983; Renes, 1953). There is a great deal of uncertainty and judgment involved in the designation of these lesions (Boorman, 1995). For this reason and because Newton et al. (1994) did not observe a dose response in either sex, and because the lesions attained statistical significance (trend test) only at the highest concentration in the female rats at 24 months (increasing the potential for confounding from spontaneous senile cataracts common among aging nocturnal albino rodents), these results can not be considered an adequate basis for a human risk assessment.

Microscopic lesions of the lungs revealed interstitial inflammation in control and exposure groups at the end of 6, 12, 18, and 24 months. Granulomatous inflammation and granulomas were observed in all exposure groups at 18 and 24 months. An increase in the number of alveolar and intraalveolar particle-laden macrophages was observed (at every exposure duration) in all but the control groups. There is no indication given in the report that the increases in particle-laden macrophages in the lungs of low- and mid- concentration group rats were anything but normal, compensatory responses. However, clearance half-times in the high-concentration groups were three times greater than in the low- and mid-concentration groups, indicating that clearance mechanisms may be compromised severely at this level of exposure. It appears that this effect is largely due to the intrinsic toxicity of antimony trioxide and not a general "particle overload" phenomenon. The rate of clearance from lungs of deposited benign or slightly toxic insoluble particles has been reported to be reduced by 50% at a dust volume of about 1000 nL (Muhle et al., 1990). Newton et al. (1994) report a 50% decrease in clearance (or increase in half-time) at an antimony trioxide volume of about 270 nL in the high-exposure group. The disproportionate increase in antimony trioxide retention in the high-exposure group can be seen by comparing the exposure concentration ratios of 1:10:90 to the lung burden ratios of 1:11:138. Thus, the NOAEL for decreased rate of clearance is 0.51 mg/cu.m [NOAEL(HEC) = 0.042 mg/cu.m].

With respect to interstitial inflammation and granulomatous inflammation, statistical significance of incidence data was not reported in the study, but the raw data from the original unpublished report (Bio/dynamics, 1990) were evaluated using trend and pairwise (Fisher Exact) tests on the statistical significance of increases in severity grades and incidence (Allen and Chapman, 1993). An evaluation of male and female graded responses for interstitial and granulomatous inflammation using logistic regression techniques indicates no effect in females at any concentration level and marginally significant effects (for increased severity of interstitial inflammation) at the high- concentration level for males during the exposure period (first 12 months). However, in the second, follow-up year, significant ($p < 0.05$) increases in the incidence and severity of these responses were evident at the high- exposure level for both male and female rats that either died spontaneously or were sacrificed at 18 and 24 months (Bio/dynamics, 1990). When incidence alone was considered (regardless of severity), chronic interstitial inflammation in the female rats that were either sacrificed or died spontaneously was increased over controls in the mid-exposure group. However, overall incidence is not considered an appropriate response measure for this lesion due to the high rate (55%) of minimal to slight interstitial inflammation in female controls and the fact that this increase was not seen among sacrificed animals, but only among those female rats that died spontaneously before normal sacrifice. When severity of these lesions is taken into consideration, the analysis of Allen and Chapman (1993) indicates a LOAEL of 4.50 mg/cu.m and a NOAEL of 0.51 mg/cu.m [NOAEL(HEC) = 0.042 mg/cu.m].

DERIVATION OF A BENCHMARK CONCENTRATION (BMC): Incidence of chronic inflammation, granulomatous inflammation and fibrosis in male, female, and combined male and female rats observed during the 1-year period were analyzed for purposes of Benchmark Concentration (BMC) analysis. To minimize the confounding rate of background lesions, only chronic inflammation given a severity grade greater than 2 (slight) and granulomatous inflammation given a severity grade greater than 1 (minimal) were considered in the BMC evaluation. The concentrations associated with 1, 5, and 10% relative increases in the probability of response were estimated using both Weibull and linear models. Although limiting the response to specific severity grades decreased the background rate, there was still enough of a response in the controls to cause a slight difference in the results of models that calculate relative (sometimes referred to as extra risk) vs. additional risk. A relative risk model was selected as most appropriate, based on the conservative assumption that the mechanisms causing the background response are independent of the mechanisms causing the treatment-related response.

Both the Weibull and linear models gave the same goodness of fit for male and female data. Although BMCs were not calculated and presented for all endpoints, as per standard operating procedures, the best curve fits and the lowest corresponding lower 95% confidence levels were obtained for chronic inflammation in female rats. A previous chronic exposure study (Groth et al., 1986) also determined female rats to be more sensitive to lung effects from antimony trioxide exposure. Further, Allen and Chapman (1993) also concluded, as a result of their analysis, that "males and females responded differently to antimony trioxide exposure for the subacute/chronic interstitial inflammation response, especially during the second, follow-up year." Because it is possible that there is a biological basis for these reported sex differences, the female data were evaluated separately. The studies by Faustman et al. (1994) and Allen et al. (1994) suggest that the 10% incidence level correlated with a NOAEL for one type of noncancer endpoint (quantal developmental effects). Consequently, a 10% relative increase was chosen as a benchmark response. The lower 95% confidence limit for the 10% relative increase in the probability of response among this subset was determined to be at 0.87 mg/cu.m. Although chronic inflammation can be considered a relatively mild, potentially compensatory effect, a similar BMC10 analysis for granulomatous inflammation and fibrosis (which can be considered to represent further progression of the inflammatory aggravation) gives BMC10 estimates of 1.21 and 2.85 mg/cu.m, respectively. Thus, more serious lesions do occur at only slightly higher concentrations. As stated earlier, when minimal and slight interstitial inflammation are included, the overall incidence of interstitial inflammation in female rats beyond the 12-month sacrifice was increased at the mid-concentration over controls. However, the high rate of minimal to slight inflammation in female controls and in animals that died prior to sacrifice suggests that the BMC10 analysis of higher severity grades is better representative of the true NOAEL. The BMC10 of 0.87 mg/cu.m was chosen for RfC derivation, and a human equivalent concentration [BMC(HEC)] of 0.074 mg/cu.m was calculated.

I.B.3. UNCERTAINTY AND MODIFYING FACTORS (INHALATION RfC)

UF -- An uncertainty factor of 10 is used for the protection of sensitive human subpopulations. An uncertainty factor of 3 is used for interspecies extrapolation because the dosimetric adjustments account for part of this area of uncertainty. An uncertainty factor of 3 is applied for data base inadequacies (principally, the lack of reproductive and developmental bioassays). Although epidemiologic studies were not considered adequate for use in a quantitative assessment, they provide qualitative support for the health endpoint selected as the basis for the RfC and obviate the need for toxicity data in a second species. Studies addressed in the next section indicate the importance of exposure dose and duration on the dynamics of reaching and maintaining a steady-state concentration and lung clearance. There is no evidence that, at the lowest exposure level tested in the Newton et al. (1994) study, the levels of antimony in the rat lungs reached a steady- state concentration. Thus, an additional threefold uncertainty factor to account for a less-than-lifetime exposure duration is applied. This is less than the 10-fold uncertainty factor normally applied to adjust from subchronic (90-day) to chronic studies because exposures lasted for 1 full year.

MF -- None

MF – None

I.B.4. ADDITIONAL STUDIES / COMMENTS (INHALATION RfC)

As studies addressed in this section illustrate, the disposition of an antimony aerosol in the respiratory tract is dependent on the particle size, distribution, and solubility of the compound. In general, aerosols containing small particles (Felicetti et al., 1974a; Leffler et al., 1984; Thomas et al., 1973) composed of antimony compounds with low water solubility (Leffler et al., 1984) (e.g., particles of antimony oxides) are retained in the lungs for a longer period of time than those containing larger particles with high water solubility (e.g., particles of antimony tartrates). This is because particle size and distribution determine the initial deposition in the respiratory tract, and subsequent clearance depends on the deposition site, rate of absorption, dissolution, extent of metabolism, and tissue distribution. Retention reflects the difference between deposition and clearance. The toxic effects of antimony compounds also will vary according to these and other variables. Limited data on antimony trisulfide indicate that the critical effect associated with exposure to this compound is cardiotoxicity, and that effects may occur at similar, if not lower, exposure levels (Brieger et al., 1954). Hence, the antimony trioxide RfC is not representative of the entire class of antimony compounds and should not be used in this manner. Most atmospheric releases of antimony result from high-temperature industrial processes that produce antimony oxides. An RfC was derived separately for antimony trioxide because it is the primary form of antimony in the atmosphere (U.S. EPA, 1980), and because there are limited toxicologic data for other forms of antimony.

Chronic occupational exposure to antimony (generally antimony trioxide) is most commonly associated with "antimony pneumoconiosis" (Cooper et al., 1968; McCallum, 1967; Potkonjak and Pavlovich, 1983; Renes, 1953). This condition is characterized on X-rays by the presence of diffuse, densely distributed punctate opacities that are round, polygonal, or irregular in shape; have a diameter of usually <1 mm; and do not tend to conglomerate (Potkonjak and Pavlovich, 1983).

Renes (1953) studied 78 employees of a mining company involved in either antimony smelting operations or maintenance. The workers were exposed to an average of 4.69 and 11.81 mg/cu.m antimony in two different work areas, and 69 of these men reported illness within the first 5 months of operation. The smelter fume contained 35-68% antimony, 2-5% arsenic, 0.01-0.04% selenium, 0.04-0.30% lead, and 0.1-0.40% copper. Exposure to caustics (hydrogen sulfide and sodium hydroxide) also was possible. Chest X-rays taken of six men who were acutely ill revealed pneumonitis.

Cooper et al. (1968) examined 28 antimony smelter workers that had been exposed to antimony ore and antimony trioxide dust for 1-15 years. Antimony concentrations ranged from 0.08-138 mg/cu.m antimony, but particle size was not specified. Pulmonary function studies were carried out on 14 of these workers, and no consistent pattern of abnormalities was observed. However, 3/13 workers who underwent roentgenographic examination were found to have antimony pneumoconiosis and 5 more were suspected of having pneumoconiosis.

McCallum (1963) reported that pneumoconiosis in antimony smelter workers in the United Kingdom was generally benign (i.e., the workers were symptomless). He reported a correlation between the degree of radiographic abnormalities, amount of antimony retained in the lungs, and duration of exposure; changes often were noted after just a few years of employment (McCallum et al., 1971). Ambient antimony (as antimony trioxide) concentrations measured 37 mg/cu.m antimony during tapping operations, and averaged 5 mg/cu.m antimony in other areas; the particle size diameter was <1 micron. In a cross-sectional study of 274 antimony smelter workers in 1965- 1966, 26 new cases of pneumonoconiosis were found (McCallum, 1967).

Potkonjak and Pavlovich (1983) investigated 51 antimony smelter workers that had been employed for 9-31 years. The workers (aged 51-54 years) were examined (physical examination, laboratory analysis, chest X-ray, and pulmonary function studies) 2-5 times over the 25-year period. The airborne dust concentrations measured 17-86 mg/cu.m, and analysis of the dust revealed 0.82-4.72% free silica, 38.73-88.86% antimony trioxide, and 2.11-7.82% antimony pentoxide. Other agents present in the dust included 0.90-3.81% ferric trioxide and 0.21-6.48% arsenic oxide. More than 80% of the particles were <5 microns in diameter. X-ray findings considered positive were characterized by the presence of diffuse, densely distributed punctate opacities having a diameter

<1 mm and concentrated in the mid-lung region and were found in many of the workers employed for over 9 years.

A subchronic study was performed (Newton et al., 1994; Bio/dynamics, 1985) in which groups of 50 Fischer 344 rats/sex were exposed to target concentrations of 0, 0.2, 1.0, 5.0, or 25.0 mg/cu.m antimony trioxide (actual concentrations were 0, 0.25, 1.08, 4.92, or 23.46 mg/cu.m, respectively) for 6 hours/day, 5 days/week for 13 weeks (duration-adjusted concentrations = 0, 0.05, 0.19, 0.88, or 4.20 mg/cu.m, respectively). The antimony trioxide was determined to be 99.93% pure. In addition, some animals were held for a 27- week recovery period. Interim sacrifices were conducted on 5 animals/sex/group at exposure weeks 1, 2, 4, 8, and 13 and at recovery weeks 1, 3, 10, 18, and 28. The protocol for exposure and the test atmosphere analysis were the same as described previously for the 1-year bioassay (Newton et al., 1994). The MMAD was 2.9, 3.9, 2.9, and 3.4 microns for the 0.25-, 1.08-, 4.92-, and 23.46-mg/cu.m levels, respectively, and sigma g was 1.6, 1.5, 1.6, and 1.5 for the four concentrations, respectively. Body weights were measured weekly during both exposure and recovery, and hematology and clinical chemistry analyses were conducted on five animals/sex/group at exposure weeks 1, 2, 4, 8, and 13 and at recovery weeks 1, 2, 4, 8, and 13. Complete gross and histopathological evaluations were conducted of all major organ tissues, including the lungs and heart, for all animals.

No exposure-related deaths occurred. Corneal irregularities and alopecia were observed in all groups (including controls) with higher incidence in the high-concentration group. Body weight was statistically significantly reduced at the two highest concentrations in both the males and the females during exposure and most of the recovery period. No significant changes in hematological parameters were observed that were concentration related or consistent across time periods. An exposure-related significant increase in aspartate transaminase was seen in the males exposed to the two highest concentrations of antimony trioxide during exposure. Mean and absolute lung weights were significantly increased in both males and females exposed to the two highest concentrations during exposure and the early part of the recovery period. Gross necropsy revealed lung discoloration in the 4.92- and 23.46- mg/cu.m groups during exposure and in the 23.46-mg/cu.m group during recovery. Microscopic lesions of the lungs observed in all animals exposed to antimony trioxide included particle-laden macrophages, degenerating macrophages, and cellular debris in the lumen of the alveoli. Multifocal pneumonocyte hyperplasia, nonsuppurative alveolitis, and focal alveolar wall thickening also were observed in both males and females exposed to 4.92 and 23.46 mg/cu.m. The macrophages, pneumonocyte hyperplasia, and alveolar wall thickening were still present after 27 weeks of recovery. No histopathologic findings were reported in any other tissues examined, including cardiac tissue. From these results, a NOAEL of 1.08 mg/cu.m [NOAEL(HEC) = 0.096 mg/cu.m], based on pulmonary effects from subchronic exposure, can be estimated.

Watt (1983) exposed groups of 50 female Wistar rats and 3 female Sinclair S-1 miniature swine to antimony trioxide for 6 hours/day, 5 days/week for 1 year. The exposure concentrations were 0, 1.9, and 5.0 mg/cu.m (duration- adjusted concentrations = 0, 0.3, and 0.9 mg/cu.m, respectively). The particle size (Ferret's diameter) was 0.44 and 0.40 microns for the low and high concentrations, respectively, and standard deviations were 2.23 and 2.13, respectively. No exposure-related effects on survival, hematology, or clinical chemistry were noted. The body weights of the exposed animals were consistently higher than the controls throughout the study. No consistent pattern of abnormalities were detected in electrocardiograms taken from swine at preexposure, after 6 months of exposure, and at the end of exposure. Lung weight was increased in both species. Nonneoplastic pulmonary effects observed in all exposed animals included focal fibrosis, adenomatous hyperplasia, multinucleated giant cells, cholesterol clefts, pneumonocyte hyperplasia, and pigmented macrophages. The severity of these effects increased with concentration and duration of exposure. Postmortem findings that appeared to be treatment related included discoloration and increased pulmonary alveolar-intralveolar macrophages in the mid- and high-exposure groups and focal subacute-chronic interstitial inflammation and granulomatous inflammation in the high-exposure group. The incidence of lung tumors (scirrhous carcinomas, squamous cell carcinomas, and bronchoalveolar adenomas) was statistically significantly increased in the animals exposed to 5.0 mg/cu.m only. No other nonneoplastic or neoplastic lesions were observed in the exposed rats, and no microscopic, exposure-related changes were observed in the swine. Based on the occurrence of pulmonary effects in rats, a LOAEL of 1.9 mg/cu.m can be estimated from this study.

Cooper et al. (1968) exposed two groups of 10 Sprague-Dawley rats/sex to powdered antimony ore or antimony trioxide at a concentration of 1,700 mg/cu.m for 1 hour, 1-6 times every 2 months. This exposure regimen trioxide at a concentration of 1,700 mg/cu.m for 1 hour, 1-6 times every 2 months. This exposure regimen continued for 66- 311 days for the ore and 66-366 days for the antimony trioxide. No control animals were included in the study. The powdered ore induced mild and transient edema and lung congestion after the first exposure. Both the ore and the trioxide exposure resulted in a phagocytic response that became apparent 66 days after the first exposure and increased in intensity with continuing exposure. The authors noted that no signs of chronic pneumonitis were apparent at 311 days for the trioxide and 366 days for the ore. As the duration of exposure increased, scattered particles with moderate reticuloendothelial proliferation was noted in the spleen. No exposure- related effects were seen in the liver or kidney. No controls were used, and details regarding protocol (e.g., number of animals sacrificed at the end of the study) and results (e.g., incidence data) were lacking.

Guinea pigs (n = 24) were exposed to antimony trioxide at a concentration of 45.4 mg/cu.m (38.1 mg/cu.m antimony) for 2 hours/day, 7 days/week for 2 weeks, followed by 3 hours/day for the duration of the experiment (8-265 days). The particle size was assumed to be less than or equal to 1 micron (Dernehl et al., 1945). The authors assumed that lung retention of antimony was 50% and calculated a daily average retention of 1.6 mg. Interstitial pneumonitis was observed in all 24 guinea pigs, and, of the four deaths that occurred, two were from pneumonia. Increased lung weight was observed at necropsy, and subpleural petechial hemorrhages were observed in animals exposed for greater than or equal to 30 days. Increased liver weight, cloudy swelling of the liver, and fatty degeneration in 73% of the animals exposed for greater than or equal to 48 days were observed. Decreased white blood counts were reported in the exposed animals, and splenic hyperplasia and hypertrophy also were noted in half of the exposed animals. Electrocardiograms were taken of three guinea pigs, and no exposure-related abnormalities were noted.

In two separate studies, Gross et al. (1952, 1955) exposed 50 male Sprague-Dawley rats to antimony trioxide dust at a concentration of 100-125 mg/cu.m (84-105 mg/cu.m antimony) for 100 hours/month for up to 14.5 months. No experimental controls were included in the 1952 study, and animals exposed to 25 mg/cu.m dust containing 1% antimony trioxide (90% calcium phosphate) served as controls in the 1955 study. The authors determined by electron microscopy that the average particle size was 0.6 microns. Death due primarily to pneumonia occurred in many of the animals. On gross examination, the lungs appeared mottled, and swelling, proliferation, and desquamation of the alveolar macrophages were observed early in the experiment and were followed by fatty degeneration, necrosis, and cell death as the exposure duration increased. Alveolar fibrosis also was observed. The authors characterized these pulmonary changes as "endogenous lipid pneumonia." Rabbits administered the same levels of antimony trioxide, according to the same treatment regimen, exhibited similar pulmonary effects. However, the interstitial pneumonia was more pronounced in the rabbits, and the fibrosis was less diffuse (Gross et al., 1955). Considerable deposits of antimony trioxide were found in the lymph nodes, but there was no fibrosis. This prompted the authors to postulate that the lung damage observed was secondary to metabolic disturbances, fatty degeneration, and necrosis of alveolar macrophages, resulting in lipid deposits that, in turn, cause fibrosis (Gross et al., 1952, 1955).

In a study sponsored by NIOSH, groups of 90 male and female Wistar rats were exposed to dusts of antimony trioxide or antimony ore for 7 hours/day, 5 days/week for up to 52 weeks (Groth et al., 1986). The exposure concentrations were 45 mg/cu.m antimony trioxide (37.8 mg/cu.m antimony) and 36-40 mg/cu.m antimony ore (17.5 mg/cu.m antimony). Rats exposed to filtered air served as controls. The duration adjusted concentrations were 9.4 mg/cu.m and approximately 7.9 mg/cu.m antimony ore, respectively. The MMADs for the two test atmospheres were 2.80 (antimony trioxide) and 4.78 (antimony ore); the sigma g values were not reported. Interim sacrifices were performed on 5 animals/sex/group at 6, 9, and 12 months, and the remainder of the animals were held for an additional 20 weeks after the termination of exposure. Slight but statistically significant decreases in mean body weight were observed in both the males exposed to antimony trioxide (6.2%) and the females exposed to antimony ore (6.4%). Slightly elevated, confluent, white and yellow foci were grossly visible on the pleural surfaces of the lungs from all exposed animals. Histologically, interstitial fibrosis, alveolar-wall cell hypertrophy and hyperplasia, and cuboidal and columnar cell metaplasia of the lungs were observed in the exposed animals after 6 months of exposure. These effects increased with respect to the size of the area affected after 12 months of exposure, and the extent of fibrosis increased after 4-5 months of recovery. Cholesterol clefts also were seen in the lungs of the exposed animals. None of these effects were seen in the control animals, and no other exposure-related nonneoplastic effects were observed. An increase in the incidence of lung tumors (squamous-cell carcinomas, bronchoalveolar adenomas, bronchoalveolar carcinomas, and scirrhous carcinomas) was seen in 27% of the females exposed to antimony trioxide and 25% of the females exposed to carcinomas) was seen in 27% of the females exposed to antimony trioxide and 25% of the females exposed to antimony ore. Based on the results of this study, a LOAEL(HEC) of 5 mg/cu.m (assumes a sigma g of 2) for antimony trioxide can be estimated for effects in the thoracic region of the respiratory tract.

Quantitative data regarding the disposition of inhaled antimony oxides in humans or laboratory animals are not available. However, antimony has been detected in the blood and urine of smelters, with and without lung changes, who were chronically exposed to antimony trioxide; urine levels of antimony often remained elevated for extended periods after exposure had terminated (Bailly et al., 1991; Brieger et al., 1954; Cooper et al., 1968; Ludersdorf et al., 1987; McCallum, 1963). This provides evidence that antimony oxides are absorbed by humans following inhalation exposure.

Data obtained from both live and deceased smelter workers indicate that antimony is retained in the lungs for long periods of time (Gerhardsson et al., 1982; McCallum, 1967; McCallum et al., 1971; Vanoeteren et al., 1986a,b,c). Gerhardsson et al. (1982) measured the antimony content of the lungs of 40 deceased smelter workers and found that the antimony levels in the exposed men (316 mg/kg) were 12-times greater ($p < 0.001$) than the levels of antimony measured in nonexposed referents. Furthermore, antimony concentration in the lungs did not tend to decrease with increasing period after cessation of exposure, which indicates that lung antimony has a long biological half-life. A series of studies conducted by Vanoeteren et al. (1986a,b,c) support the observation that antimony accumulates in lung and is retained for long periods of time.

The absorption and retention of antimony following inhalation exposure has been studied in laboratory animals, and the results support the observations made in humans that antimony can be retained in the lung (Newton et al., 1994; Felicetti et al., 1974a; Leffler et al., 1984; Thomas et al., 1973). These investigators have demonstrated that the extent of deposition and subsequent clearance and retention of antimony from the lung depends primarily on solubility (Leffler et al., 1984) and particle size (Felicetti et al., 1974a; Leffler et al., 1984; Thomas et al., 1973). Thomas et al. (1973) exposed mice to aerosols of radiolabeled trivalent antimony as a tartrate complex for 10 minutes. The aerosols were generated at three different temperatures (100, 500, and 1100 F) that yielded particle sizes (activity median aerodynamic diameter) of 1.6, 0.7, and 0.3 microns, respectively (with sigma g's of 1.9, 1.8, and 1.3, respectively). Whole-body scintillation counting was conducted immediately after exposure and at various intervals thereafter; serial sacrifices to determine tissue distribution were conducted at 0, 2, 4, 8, 16, and 32 days postexposure. The results of the serial whole-body counts revealed that antimony was cleared rapidly at first, and this initial, rapid phase was followed by a slower, steady decrease in antimony content. The aerosol generated at 100 F was more soluble than those generated at 500 and 1100 F; the more soluble material was cleared from the lung and absorbed into the systemic circulation at a higher rate (to be preferentially accumulated in the bone) than the aerosols generated at higher temperatures. Consequently, the less soluble and smaller particles that were generated at higher temperatures tended to be retained in the lung for long periods of time. Similar results were obtained in dogs exposed to antimony aerosols generated at 100, 500, and 1100 F having particle sizes of 1.3, 1.0, and 0.3 microns, respectively (Felicetti et al., 1974a). The largest-sized particles demonstrated relatively rapid clearance from the upper respiratory tract, due in part, perhaps, to solubilization and absorption in the lung and rapid excretion via the urine. The smaller sized, less soluble particles were retained to a higher degree and for a longer duration in both the lungs and the whole body.

Leffler et al. (1984) reported that solubility had the greatest influence on the degree of lung retention of antimony in hamsters following intratracheal instillation. They treated hamsters with both copper smelter dust (volume median diameter of 5.0 microns with a sigma g of 2.1 microns), which contained 1.6% (by weight) antimony, or with pure antimony trioxide (volume median diameter of 7.0 microns with a sigma g of 2.2 microns). The results of these experiments were compared with experiments in which arsenic containing dust and pure arsenic trioxide were instilled intratracheally. Arsenic dust and arsenic trioxide are much more soluble than antimony dust or antimony trioxide. Lung clearance was characterized by two phases. In the initial phase, approximately 20% of the instilled pure antimony trioxide and approximately 35% of the instilled antimony dust were eliminated from the lungs during the first 20 hours (half-life of elimination was approximately equal to 40 hours for pure antimony and 30 hours for antimony dust). The second phase was slow, with half-lives of elimination of 20-40 days for both forms of antimony. The authors also instilled various particle sizes of antimony trioxide and found that, although there was a somewhat lower lung retention of antimony at larger particle sizes, the solubility of the particles was more influential in determining lung retention. The more soluble arsenic dust and arsenic trioxide were cleared more influential in determining lung retention. The more soluble arsenic dust and arsenic trioxide were cleared much more quickly than antimony.

Antimony trioxide levels were measured in the chronic study conducted by Newton et al. (1994). The rate at which antimony trioxide was cleared by the lungs depended on the dose, with clearance half-times of 2.3, 3.6, and 9.5 months for the low-, mid-, and high-concentration groups. These results suggest that clearance is dependent on lung burden. Substantial amounts of antimony were found in the lungs of these animals after 1 year of exposure (10.6, 120, and 1460 micrograms/g lung tissue in the three exposure groups, respectively).

Data obtained from humans indicate that, as discussed above, inhaled antimony tends to accumulate in the lung, but is relatively rapidly cleared from other tissues. Gerhardsson et al. (1982) found no difference in antimony levels in either liver or kidney in deceased smelter workers, as compared with nonexposed referents.

Experiments in laboratory animals have shown that aerosols of trivalent antimony (tartrate) are distributed primarily to the lung, bone, liver, pelt, and thyroid following inhalation exposure and are excreted both in the feces and in the urine (Felicetti et al., 1974a; Thomas et al., 1973). Significant levels of antimony were found in the lungs and RBCs of animals inhaling antimony trioxide (Newton et al., 1994). Felicetti et al. (1974b) compared the distribution of trivalent vs. pentavalent antimony inhaled as tartrate in hamsters. The liver accumulated more of the trivalent than the pentavalent form, whereas the opposite was true for the skeleton. Trivalent antimony in blood concentrated almost exclusively in the RBCs, whereas pentavalent antimony in blood was found to a greater extent in the plasma during the first 2 hours postexposure, after which, pentavalent antimony also concentrated in the RBCs. In an English abstract of a Russian study, Chekunova (1971) reported that high levels of antimony were found in blood and lungs, with the levels in liver, kidneys, spleen, and pancreas being similar following "chronic poisoning of rats by inhalation of antimony pentachloride and pentafluoride."

Bailly et al. (1991) studied the metabolism and excretion of antimony following parenteral administration of antimony trichloride to rats, in a woman who attempted suicide by ingesting antimony trisulfide, and in workers occupationally exposed to antimony pentoxide. No methylation of antimony was found in humans or animals. Antimony is excreted primarily in bile (conjugated to glutathione) and in urine. Urinary excretion of pentavalent antimony in exposed workers correlated with the level of exposure.

Gynecological examinations were performed on women (number not specified) occupationally exposed to dust containing metallic antimony, antimony trioxide, and antimony pentasulfide over a period of 2 years (Belyaeva, 1967). These women were compared with a group of control women, who, presumably, were not exposed. The level of exposure was not specified, and it is not known how the control group was selected, whether several important confounding variables were controlled for, or whether concurrent exposure to other potentially toxic substances occurred. A higher incidence of "various sexual disturbances" was reported in the exposed women as compared with controls (77.5% vs. 56.0%); these included disturbances of the menstrual cycle in 61.2% of the exposed women (as compared with 35.7% of the controls), inflammatory disease in 30.4% (as compared with 55.3% of the controls), and other ailments of the sexual organs in 8.4% of the exposed workers. Antimony was detected in the blood of the exposed workers at levels 10 times higher than in the controls. Antimony also was measured in the urine, breast milk, amniotic fluid, placental tissue, and umbilical cord blood of the exposed workers. The incidence of spontaneous abortions was 12.5% in the exposed women as compared with 4.1% in the controls, and the incidence of premature births was 3.4% (1.2% in the controls). The birth weights of children born to the exposed women were comparable to those of children born to the controls, but body weight of the children of exposed women began to lag considerably after 1 year.

Balyaeva (1967) also exposed female rats to antimony trioxide dust by inhalation for a total of 1.5-2.0 months at a concentration of 250 mg/cu.m (210 mg/cu.m antimony) for 4 hours/day. Exposure began 3-5 days before estrus and continued through mating and gestation until 3-5 days prior to delivery. Only 16/24 exposed rats became pregnant; 10/10 control rats were pregnant. The average litter size was smaller in the exposed rats (6.2 vs. 8.3 in the controls). No teratogenic effects were seen in the fetuses of the exposed animals. No data were presented on the incidence of resorption or fetal deaths. In addition, no fetal abnormalities were seen in animals given a single dose of metallic antimony (50 mg/kg) 3-5 days prior to mating.

I.B.5. CONFIDENCE IN THE INHALATION RfC

I.B.5. CONFIDENCE IN THE INHALATION RfC

Study -- Medium
Data Base -- Medium
RfC -- Medium
Medium confidence is placed in the critical study because, although it used an adequate number of animals, adequately characterized the exposure atmosphere, and thoroughly examined the respiratory tract, it was not a chronic, lifetime study. Medium confidence is placed in the data base because no adequate developmental or reproductive toxicity studies are available, although the human studies do suffice for toxicity data in a second species. A medium confidence in the RfC follows.

I.B.6. EPA DOCUMENTATION AND REVIEW OF THE INHALATION RfC

Source Document -- This assessment is not presented in any existing U.S. EPA document.

This assessment was peer reviewed by external scientists. This review was completed on August 31, 1993. Their comments have been carefully evaluated and considered in the revision and finalization of this IRIS summary. A record of these comments is included in the IRIS documentation files.

Other EPA Documentation -- U.S. EPA, 1980, 1985, 1987, 1989
Agency Work Group Review -- 02/09/93, 09/23/93, 05/10/95
Verification Date -- 05/10/95

I.B.7. EPA CONTACTS (INHALATION RfC)

Please contact the Risk Information Hotline for all questions concerning this assessment or IRIS, in general, at (513)569-7254 (phone), (513)569-7159 (FAX) or RIH.IRIS@EPAMAIL.EPA.GOV (internet address).

II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Antimony trioxide
CASRN -- 1309-64-4
Not available at this time.

VI. BIBLIOGRAPHY

Substance Name -- Antimony trioxide
CASRN -- 1309-64-4
Last Revised -- 09/01/95

VI.A. ORAL RfD REFERENCES

None

VI.B. INHALATION RfC REFERENCES

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Concentration and distribution. Sci. Total Environ. 54(0): 217-230.

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VI.C. CARCINOGENICITY ASSESSMENT REFERENCES

None

VII. REVISION HISTORY

Substance Name -- Antimony trioxide
CASRN -- 1309-64-4

Date	Section	Description
03/01/93	I.B.	Inhalation RfC now under review
11/01/93	I.B.	Work group review date added
06/01/95	I.B.	Work group review date added
09/01/95	I.B.	Inhalation RfC summary on-line
09/01/95	VI.B.	Inhalation RfC references on-line

SYNONYMS

Substance Name -- Antimony trioxide
CASRN -- 1309-64-4
Last Revised -- 03/01/93

1309-64-4
Antimony oxide
Diantimony trioxide
A 1530
A 1582
A 1588LP
AMSPEC-KR
Antimonious oxide
Antimony peroxide
Antimony sesquioxide
Antimony trioxide
ANTIMONY WHITE
ANTIMONY(3+) OXIDE
ANTOX
ANZON-TMS

ANZON-TMS
AP 50
BLUE STAR
C.I. PIGMENT WHITE 11
C.I. 77052
CHEMETRON FIRE SHIELD
CI PIGMENT WHITE 11
CI 77052
DECHLORANE A-O
Exitelite
Extrema
FLOWERS of ANTIMONY
HSDB 436
NCI-C55152
Nyacol A 1510LP
NYACOL A 1530
Senarmontite
Thermoguard B
Thermoguard S
Timonox
TWINKLING STAR
Valentinite
Weisspiessglanz [German]
WHITE STAR

ANTIMONY TRIOXIDE

HAZARDTEXT(R) - Hazard Management

1.0 IDENTIFICATION

1.1 SYNONYMS

ANTIMONY TRIOXIDE
A 1530
A 1582
A 1588LP
AMSPEC-KR
ANTIMONIOUS OXIDE
ANTIMONY OXIDE
ANTIMONY(3+) OXIDE
ANTIMONY PEROXIDE
ANTIMONY SESQUIOXIDE
ANTIMONY WHITE
ANTOX
ANZON-TMS
AP 50
BLUE STAR
CHEMETRON FIRE SHIELD
C.I. PIGMENT WHITE 11
DECHLORANE A-O
DIANTIMONY TRIOXIDE
EXITELITE
EXTREMA
FLOWERS OF ANTIMONY
NYACOL A 1510LP
NYACOL A 1530
SENARMONTITE
THERMOGUARD B
THERMOGUARD S
TIMONOX
TWINKLING STAR
VALENTINITE
WEISSPIESSGLANZ (GERMAN)
WHITE STAR

1.2 IDENTIFIERS

1.2.1 CAS REGISTRY NUMBER:
CAS 1309-64-4

1.2.2 NIOSH/RTECS NUMBER:
NIOSH/RTECS CC 5650000

1.2.3 UN/NA NUMBER:
9201 - Antimony trioxide

1.2.4 STCC NUMBER:
STCC 4966905

1.2.5 DESIGNATIONS:

C.I. 77052
NCI-c 55152
OHM/TADS NUMBER: 7217222
WISWESSER NOTATION: .SB2.O3

1.2.6 MOLECULAR FORMULA:

O3-Sb2

1.2.7 NAERG GUIDE NUMBER:

171 - SUBSTANCES (LOW TO MODERATE HAZARD)

1.3 SYNONYM REFERENCE

A. HSDB, 1992; RTECS, 1992

1.4 USES/FORMS/SOURCES

A. Antimony trioxide exists as odorless, white crystals, cubes or powder: It exists in the vapor phase as Sb4O6 (Budavari, 1989; Sax & Lewis, 1989; Sax & Lewis, 1987).
B. It is used in the manufacture of tartar emetic; as paint pigment; in enamels and glasses; as mordant; in flame-proofing of textiles, canvas, paper, and plastics (chiefly polyvinyl chloride); as ceramic opacifier; as a catalyst; as an intermediate; and in staining iron and copper (Budavari, 1989; Sax & Lewis, 1987).

3.0 CLINICAL EFFECTS

3.1 GENERAL CLINICAL EFFECTS

A. The primary toxicity of antimony trioxide is pulmonary, but myocardial, liver, and kidney damage as well as mucous membrane irritation may be seen.
B. 1996 NAERG INFORMATION
1. HEALTH HAZARDS - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
   a. Inhalation of material may be harmful.
   b. Contact may cause burns to skin and eyes.
   c. Inhalation of Asbestos dust may have a damaging effect on the lungs.
   d. Fire may produce irritating, corrosive and/or toxic gases.
   e. Runoff from fire control may cause pollution.
   f. Reference: NAERG, 1996.

5.0 MEDICAL TREATMENT

5.1 LIFE SUPPORT

A. Support respiratory and cardiovascular function.

5.2 SUMMARY

A. Treatment is primarily supportive. Chelators such as BAL and unithiol have been used in some countries.
B. 1996 NAERG INFORMATION -
1. FIRST AID - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
   a. Move victim to fresh air.
   b. Call emergency medical care.
   c. Apply artificial respiration if victim is not breathing.
   d. Administer oxygen if breathing is difficult.

d. Administer oxygen if breathing is difficult.
e. Remove and isolate contaminated clothing and shoes.
f. In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
g. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.
h. Reference: NAERG, 1996.

C. GENERAL - Treatment is primarily supportive. Chelators such as BAL and unithiol have been used in some countries (IRPTC, 1984).

D. INHALATION EXPOSURE -

1. DECONTAMINATION: Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Administer 100 percent humidified supplemental oxygen with assisted ventilation as required.

E. DERMAL EXPOSURE -

1. DECONTAMINATION: Wash exposed area extremely thoroughly with soap and water. A physician may need to examine the area if irritation or pain persists.

F. EYE EXPOSURE -

1. DECONTAMINATION: Exposed eyes should be irrigated with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should be seen in a health care facility.

G. ORAL EXPOSURE -

1. EMESIS: May be indicated in recent substantial ingestion unless the patient is or could rapidly become obtunded, comatose or convulsing. Is most effective if initiated within 30 minutes. (Dose of Ipecac Syrup: ADULT: 30 mL; CHILD 1 to 12 years: 15 mL).

2. ACTIVATED CHARCOAL/CATHARTIC: Administer charcoal slurry, aqueous or mixed with saline cathartic or sorbitol. The FDA suggests 240 mL of diluent/30 g of charcoal. Usual charcoal dose is 30 to 100 grams in adults and 15 to 30 grams in children (1 to 2 g/kg in infants).

a. Administer one dose of a cathartic, mixed with charcoal or given separately. See "Treatment: Prevention of Absorption" in the main document.

3. Chelators such as BAL and unithiol have been used in some countries to decrease serum antimony levels (IRPTC, 1984).

6.0 RANGE OF TOXICITY

6.1 MINIMUM LETHAL EXPOSURE

A. GENERAL/SUMMARY

1. The minimum lethal human exposure to this agent has not been delineated.

6.2 MAXIMUM TOLERATED EXPOSURE

A. ROUTE OF EXPOSURE

1. Exposure to 0.5 to 5 milligrams/cubic meter of dust and fumes in an antimony plant (presumably primarily antimony trioxide) resulted in only radiographic changes without systemic toxicity (McCallum, 1963).

6.3 TOXICITY VALUES

A. References: RTECS, 1992; Sax & Lewis, 1989

- TCLo - (INHL) RAT: 4200 mcg/m(3) for 52W-I -- CAR
- TC - (INHL) RAT: 4 mg/m(3) for 1Y-I -- ETA
- TD - (INHL) RAT: 1600 mcg/m(3) for 52W-I -- NEO
- LD - (SC) MAMMAL: > 120 mg/kg
- LDLo - (SC) RABBIT: 2500 mcg/kg
- LDLo - (IV) DOG: 3 mg/kg
- LD50 - (ORAL) RAT: > 20 g/kg

- LD50 - (ORAL) RAT: > 20 g/kg
- LD50 - (IP) RAT: 3250 mg/kg
- LD50 - (IP) MOUSE: 172 mg/kg

7.0 STANDARDS AND LABELS

7.1 WORKPLACE STANDARDS

A. ACGIH-TLV: Listed (as Antimony trioxide production) (ACGIH, 1997)
1. no TWA; no STEL
2. Skin Notation: Not Listed
3. A2-suspected human carcinogen
B. OSHA PEL: Not Listed (OSHA, 1996a)
C. OSHA List of Highly Hazardous Chemicals, Toxics and Reactives: Not Listed (OSHA, 1996)
D. NIOSH VALUES: (NIOSH, 1996)
1. REL: Not Listed
2. IDLH VALUE: Not Listed
E. AIHA WEEL VALUE: Not Listed (AIHA, 1996)

7.2 ENVIRONMENTAL STANDARDS

A. SARA TITLE III
1. EHS (EXTREMELY HAZARDOUS SUBSTANCES) LIST: Not Listed (EPA, 1996f)
2. SECTION 313: Not Listed (EPA, 1996g)
B. CERCLA; HAZARDOUS SUBSTANCES and REPORTABLE QUANTITIES: Listed (EPA, 1996e)
1. Statutory RQ (Reportable Quantity):
    a. 5000 pounds
    b. Codes: Listed
    (1) 1 - Indicates that the statutory source for designation of this hazardous substance under CERCLA is CWA Section 311(b)4.
2. Final RQ (Reportable Quantity):
    a. 1000 pounds (454 kilograms)
    b. Notes: Not Listed
    c. Final RQ Category: C
C. RCRA HAZARDOUS WASTE NUMBER: Not Listed (EPA, 1996; EPA, 1996a; EPA, 1996b; EPA, 1996c; EPA, 1996d)
D. TSCA INVENTORY: Listed (LOLI, 1996)
E. AIHA ERPG VALUES: Not Listed (AIHA, 1996)
F. DOT List of Marine Pollutants: Not Listed (DOT, 1996a)

7.3 SHIPPING REGULATIONS

7.3.1 SURFACE
A. Table of Hazardous Materials and Special Provisions: Not Listed (DOT, 1996)

7.3.2 AIR
A. INTERNATIONAL (IATA, 1996)
1. Not Liste

8.0 HANDLING AND STORAGE

8.3 STORAGE

8.3.2 ROOM/CABINET RECOMMENDATIONS
A. Antimony compounds should be stored in a cool, well-ventilated place (HSDB, 1992).

A. Antimony compounds should be stored in a cool, well-ventilated place (HSDB, 1992).
B. Store out of the direct rays of the sun, and away from areas of high fire hazard (HSDB, 1992).
C. The stored material should be periodically inspected (HSDB, 1992).
D. Incompatible materials should be isolated (HSDB, 1992).

9.0 PERSONAL PROTECTION

9.1 SUMMARY

A. PROTECTIVE CLOTHING - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. Wear positive pressure self-contained breathing apparatus (SCBA).
2. Structural firefighters' protective clothing will only provide limited protection.
3. Reference: NAERG, 1996.

9.3 RESPIRATORY PROTECTION

A. RESPIRATORY RECOMMENDATIONS - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. Wear positive pressure self-contained breathing apparatus (SCBA).
2. Reference: NAERG, 1996.
B. Refer to "Recommendations for respirator selection" in the NIOSH Pocket Guide to Chemical Hazards on TOMES Plus(R) for respirator information.

9.4 PROTECTIVE CLOTHING

A. INTERPRETATION
1. This section consists of a compilation of chemical compatibility recommendations and test data from various reference sources to facilitate protective clothing selection.
2. These recommendations are compiled from published sources and are NOT recommended specifically by Micromedex(R), Inc. No attempt has been made to verify the data presented.
3. There are many critical variables in protective clothing selection that cannot be represented in this summary of the literature. For example, there may be significant differences in the protection offered by the same generic material from one commercial product to another and one lot to another. Refer to "PERSONAL PROTECTIVE EQUIPMENT

- OSHA PUB 3077" INFOTEXT document for general information on protective clothing selection.
4. Therefore, these recommendations should not be used as the sole basis for decisions on choice of protective clothing, but rather should be used as a tool by qualified occupational health and safety professionals or other technically qualified persons in conjunction with a review of all mitigating factors.
5. The presence of a specific product within this section does not in any way constitute an endorsement of said product. Material types have been omitted if no test data or recommendations were found in any of the references consulted.
6. All product recommendations should be confirmed with the specific manufacturer for verification of product performance.
B. BUTYL RUBBER
1. Synonyms: IIR, Butyl
2. General Recommendations:
    a. No recommendation (Forsberg & Mansdorf, 1989)
    b. No recommendation (ACGIH, 1987)
    c. NFPA Summary (Henry, 1989):

    - COMPATIBLE (1980 Coast Guard Study)
3. Specific Products in alpha order:
    a. No specific product recommendations were found for this material (Forsberg & Keith, 1991).
C. POLYCARBONATE

1. Synonyms: PC
2. General Recommendations:
   a. No recommendation (Forsberg & Mansdorf, 1989)
   b. No recommendation (ACGIH, 1987)
   c. NFPA Summary (Henry, 1989):

   - COMPATIBLE (1980 Coast Guard Study)
3. Specific Products in alpha order:
   a. No specific product recommendations were found for this material (Forsberg & Keith, 1991).

10.0 PHYSICAL HAZARDS

10.1 FIRE HAZARD

10.1.1 SUMMARY

A. FIRE OR EXPLOSION HAZARDS - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. Some may burn but none ignite readily.
2. Some may polymerize explosively when heated or involved in a fire.
3. Containers may explode when heated.
4. Some may be transported hot.
5. Reference: NAERG, 1996.

B. PUBLIC SAFETY, GENERAL - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number: CANADA 1) CANUTEC: 613-996-6666 (Collect calls are accepted.) UNITED STATES 1) CHEMTREC(R): 1-800-424-9300 (Toll-free in the U.S. and Canada); 703-527-3887 for calls originating elsewhere (Collect calls are accepted) OR 2) CHEM-TEL, INC.: 1-800-255-3924 (Toll-free in the U.S. and Canada); 813-979-0626 for calls originating elsewhere (Collect calls are accepted) 3) MILITARY SHIPMENTS: 703-697-0218 - Explosives/ammunition incidents (Collect calls are accepted); 1-800-851-8061 - All other dangerous goods incidents MEXICO 1) SETIQ: 91-800-00-214 in the Mexican Republic; For calls originating in Mexico City and the Metropolitan Area: 575-0838, 575-0842 or 559-1588 For calls originating elsewhere, call: 0-11-52-5-575-0838 or 0-11-52-5-575-0842 2) CECOM: 91-800-00-413 in the Mexican Republic For calls originating in Mexico City and the Metropolitan Area: 550-1496, 550-1552, 550-1485, or 550-4885; FAX 616-5560 Or 616-5561 For calls originating elsewhere, call: 0-11-52-5-550-1496, 0-11-52-5-550-1552, 0-11-52-5-550-1485, or 0-11-52-5-550-4885
2. Isolate spill or leak area immediately for at least 10 to 25 meters (30 to 80 feet) in all directions.
3. Keep unauthorized personnel away.
4. Stay upwind.
5. Reference: NAERG, 1996.

C. Antimony trioxide is nonflammable (CHRIS, 1992).

D. Antimony trioxide (powder) ignites on heating in air (Bretherick, 1990).

10.1.6 FIRE CONTROL/EXTINGUISHING AGENTS

A. SMALL FIRES - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. Dry chemical, CO2, water spray or regular foam.
2. Reference: NAERG, 1996.

B. LARGE FIRES - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. Water spray, fog or regular foam.
2. Move containers from fire area if you can do it without risk.
3. Do not scatter spilled material with high pressure water streams.
4. Dike fire-control water for later disposal.
5. Reference: NAERG, 1996.

C. FIRE INVOLVING TANKS - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. Cool containers with flooding quantities of water until well after fire is out.
2. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
3. ALWAYS stay away from the ends of tanks.

3. ALWAYS stay away from the ends of tanks.
4. Reference: NAERG, 1996.

10.1.7 COMBUSTION TOXICITY

A. When heated to decomposition, antimony trioxide emits toxic antimony fumes (Sax & Lewis, 1989).

10.2 EXPLOSION HAZARD

A. FIRE OR EXPLOSION HAZARDS - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. Some may burn but none ignite readily.
2. Some may polymerize explosively when heated or involved in a fire.
3. Containers may explode when heated.
4. Some may be transported hot.
5. Reference: NAERG, 1996.

B. PUBLIC SAFETY, GENERAL - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed in the FIRE HAZARD section of this document.
2. Isolate spill or leak area immediately for at least 10 to 25 meters (30 to 80 feet) in all directions.
3. Keep unauthorized personnel away.
4. Stay upwind.
5. Reference: NAERG, 1996.

10.3 DUST/VAPOR HAZARD

A. PUBLIC SAFETY, GENERAL - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed in the FIRE HAZARD section of this document.
2. Isolate spill or leak area immediately for at least 10 to 25 meters (30 to 80 feet) in all directions.
3. Keep unauthorized personnel away.
4. Stay upwind.
5. Reference: NAERG, 1996.

B. When heated to decomposition, antimony trioxide emits toxic antimony fumes (Sax & Lewis, 1989).

10.4 REACTIVITY HAZARD

A. When heated to decomposition, antimony trioxide emits toxic antimony fumes (Sax & Lewis, 1989).
B. Antimony trioxide is incompatible with chlorinated rubber and heat of 216 degrees C; and bromine trifluoride (Sax & Lewis, 1989).
C. Antimony trioxide (powder) ignites on heating in air (Bretherick, 1990).

10.5 EVACUATION PROCEDURES

10.5.1 SUMMARY

A. No specific Isolation - Protective Action Distances have been established for this substance.

B. EVACUATION (FIRE) - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.
2. Reference: NAERG, 1996.

C. PUBLIC SAFETY, GENERAL - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed in the FIRE HAZARD section of this document.
2. Isolate spill or leak area immediately for at least 10 to 25 meters (30 to 80 feet) in all directions.
3. Keep unauthorized personnel away.
4. Stay upwind.
5. Reference: NAERG, 1996.

5. Reference: NAERG, 1996.

10.6 CONTAINMENT/DISPOSAL GUIDELINES

10.6.1 SUMMARY

A. SPILL OR LEAK, GENERAL - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. Do not touch or walk through spilled material.
2. Stop leak if you can do it without risk.
3. Prevent dust cloud.
4. Avoid inhalation of asbestos dust.
5. Reference: NAERG, 1996.

B. At the time of this review, criteria for land treatment or burial (sanitary landfill) disposal practices are subject to significant revision. Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices (HSDB, 1992).

10.6.2 SMALL LEAK/SPILL

A. SMALL SPILLS - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
2. Reference: NAERG, 1996.

B. SMALL DRY SPILLS - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
2. Reference: NAERG, 1996.

10.6.3 LARGE LEAK/SPILL

A. LARGE SPILLS - NAERG (SUBSTANCES (LOW TO MODERATE HAZARD)) - GUIDE 171
1. Dike far ahead of liquid spill for later disposal.
2. Cover powder spill with plastic sheet or tarp to minimize spreading.
3. Prevent entry into waterways, sewers, basements or confined areas.
4. Reference: NAERG, 1996.

11.0 ENVIRONMENTAL HAZARD MANAGEMENT

11.1 POLLUTION HAZARD

A. Antimony trioxide is released to the atmosphere during processing of antimony materials, including smelting of ores, molding and incineration of products, and the combustion of fossil fuels. Industrial dust and exhaust gases of cars and oil fuels are the main sources of antimony in urban air (HSDB, 1992).
B. Antimony occurs in the earth's crust as about 2 X 10(-1) to 10 x 10(-1) mg/kg and in seawater at about 2 x 10(-4) mg/kg. It is found mainly as sulfides and oxides, sometimes as native metal. About 114 minerals containing antimony are known (HSDB, 1992).

11.3 ENVIRONMENTAL KINETICS

A. Antimony is expected to exist as the trioxide in the atmosphere, since most of the atmospheric releases of antimony substances result from high temperature industrial processes, from the combustion of petroleum, petroleum products and coal, and from the incineration of products that contain antimony. At the high temperatures used in these processes, oxidation of the antimony substances occurs, resulting in the formation of antimony trioxide (and possibly also antimony tetraoxide and antimony pentoxide) (HSDB, 1992).
B. Loss of antimony oxides from water through volatilization is very unlikely under normal environmental conditions due to their very low concentrations and the low concentration of their hydrolysis products, and also due to their polarity and extremely low vapor pressures (HSDB, 1992).

11.7 ENVIRONMENTAL TOXICITY

A. Ecotoxicity Values (HSDB, 1992):

1. LD50, Lepomis macrochirus (bluegill sunfish), greater than 530 mg/L/96 hours, conditions of bioassay not specified
2. LD50, Pimephales promelas (fathead minnow), greater than 833 mg/L/96 hours, conditions of bioassay not specified

12.0 PHYSICAL/CHEMICAL PROPERTIES

12.1 MOLECULAR WEIGHT

A. 291.52 (Budavari, 1989)

12.2 DESCRIPTION/PHYSICAL STATE

A. Antimony trioxide is a white, odorless, solid (ACGIH, 1986).
B. It exists as odorless, white crystals, cubes or powder (Budavari, 1989; Sax & Lewis, 1989; Sax & Lewis, 1987)

12.3 PH

A. Antimony trioxide is amphoteric (Sax & Lewis, 1987).

12.4 VAPOR PRESSURE

A. 1 mmHg (at 574 degrees C) (HSDB, 1992)

12.6 DENSITY

A. SOLID: 5.67 g/cm(3) (NL-TP) (Sax & Lewis, 1987) KEY NL-TP: Not Listed, Temperature and Pressure NTP: Normal Temperature and Pressure (25 degrees C; 77 degrees F and 760 mmHg) OTHER-TP: Other, Temperature and Pressure STP: Standard Temperature and Pressure (0 degrees C; 32 degrees F and 760 mmHg)

12.7 FREEZING/MELTING POINT

A. MELTING POINT: 655 degrees C (Budavari, 1989)

12.8 BOILING POINT

A. 1425 degrees C (sublimes in high vacuum at 400 degrees C) (Budavari, 1989)

12.9 FLASH POINT

A. No information found at the time of this review.

12.11 EXPLOSIVE LIMITS

12.11.1 LOWER
A. No information found at the time of this review.

12.11.2 UPPER
A. No information found at the time of this review.

12.12 SOLUBILITY

A. SOLUBILITY IN WATER

1. slightly soluble in water (Budavari, 1989)
B. SOLUBILITY, OTHER
1. Slightly soluble in dilute H_2SO_4 or dilute HNO_3 (Budavari, 1989).
2. Solubility in dilute HCl (0.1 moles HCl/kg H_2O): approximately 1x10(-4) g-atoms Sb/kg H_2O. Solubility increases with increasing HCl concentration (Budavari, 1989).
3. Soluble in solutions of alkali hydroxides or sulfides, and in warm solution of tartaric acid or of bitartrates (Budavari, 1989).

12.13 REACTIVITY

12.13.2 HAZARDOUS REACTIONS

A. When heated to decomposition, antimony trioxide emits toxic antimony fumes (Sax & Lewis, 1989).
B. Antimony trioxide is incompatible with chlorinated rubber and heat of 216 degrees C; and bromine trifluoride (Sax & Lewis, 1989).
C. Antimony trioxide (powder) ignites on heating in air (Bretherick, 1990).

13.0 SAMPLING AND ANALYTICAL METHODS

13.2 AIR

A. Antimony in air may be determined by hydride generation and atomic absorption spectroscopy.

13.3 WATER

A. No analytical methods for antimony trioxide were found in available references at the time of this review. The following methods are for total antimony (HSDB, 1992):
1. EPA Method 7040 is applicable for the determination of metals, including antimony, in solution by atomic absorption spectrometry (direct aspiration technique). Preliminary treatment of waste water, groundwater, extraction procedure extracts, and industrial waste is always necessary. Using this method, the detection limit of an aqueous sample free of interferences is 0.02 mg/L.
2. EPA Method 7041 is applicable for the determination of metals, including antimony, in solution by atomic absorption spectrometry (furnace technique). For certain samples, lower concentrations may be determined using this technique. To ensure valid data, each matrix must be examined for interference effects, and treated accordingly, if detected.
3. EPA Method 304 is an electrothermal atomization atomic absorption spectrometry method for the determination of micro quantities of selected elements, including antimony, in water and waste water samples. The estimated detection limit is 3 mcg/L.
4. Trace amounts of antimony in effluents may be determined by differential pulse anodic stripping voltametry.

13.5 FOOD

A. Antimony in foods may be determined by rapid hydride evolution and atomic absorption spectrometry.

14.0 REFERENCES

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14.3 CONSULTANTS

A. CHEMTREC
1. The above information is generic for the compound. For further product specific information, consult manufacturer. In an emergency, contact CHEMTREC at 1-800-424-9300 or 703-527-3887 if outside the continental U.S.
2. Immediately notify the National Response Center (1-800-424-8802) if a release of a reportable quantity of a hazardous substance to the environment has occurred.
B. EPA ENVIRONMENTAL RESPONSE TEAM 1 In case of a large spill or release, notify appropriate local pollution, fire, and emergency response authorities. Seek 24-hour professional environmental engineering assistance through the EPA's Environmental Response Team (ERT), Edison, New Jersey (201) 321-6660.

15.0 AUTHOR INFORMATION

15.1 CONTRIBUTOR(S) TO THIS DOCUMENT

A. Written by: POISINDEX(R) system staff, 08/87
B. Revised by: Patricia M Bill, BA, 07/92
C. Reviewed by: Alan H Hall, MD, 12/92

D. Personal Protection information was reviewed by Barry E North, PhD, MPH, CIH, 11/92
E. In addition to standard revisions of this management, certain portions were updated with recent literature: 02/96
F. Specialty Board: Hazard (DT0634)

ANTIMONY TRIOXIDE

CHRIS - Chemical Hazard Response Information System

OVERVIEW

Material name:

ANTIMONY TRIOXIDE
CHRIS Code ATX

Common synonyms:

Diantimony trioxide
Senarmontite
Valentinite
Exitelite
Weisspiessglanz
Flowers of antimony

Characteristics:

Solid White Odorless
Sinks in water.

Emergency actions:

AVOID CONTACT WITH SOLID AND DUST. KEEP PEOPLE AWAY.
Wear dust respirator and rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire:

Not flammable.

Exposure:

CALL FOR MEDICAL AID.

DUST
POISONOUS IF INHALED OR IF SKIN IS EXPOSED.
If inhaled will cause coughing, difficult breathing or loss of consciousness.
If in eyes, hold eyelids open and flush with plenty of water.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

SOLID
POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.
If swallowed will cause dizziness, nausea, vomiting or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.

IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water pollution:

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

RESPONSE TO DISCHARGE

Issue warning-poison Restrict access Should be removed
Chemical and physical treatment

LABEL

Category: None
Class: Not pertinent

CHEMICAL DESIGNATIONS

CG compatibility class: Not listed
Formula: Sb(2)O(3)
IMO/UN designation: 6.1/1549
DOT id no.: 1549
CAS registry no.: 1309-64-4

OBSERVABLE CHARACTERISTICS

Physical state: Solid
Color: White
Odor: None

HEALTH HAZARDS

Personal protective equipment: Rubber gloves; safety goggles; dust mask
Symptoms following exposure: Inhalation causes inflammation of upper and lower respiratory tract, including pneumonitis. Ingestion causes irritation of the mouth, nose, stomach and intestines; vomiting, purging with bloody stools; slow pulse and low blood pressure; slow, shallow breathing; coma and convulsions sometimes followed by death. Contact with eyes causes conjunctivitis. Contact with skin causes dermatitis andrhinitis.
Treatment of exposure: If any of the symptoms of poisoning, even slight, are noticed, the affected individual should be removed from contact with the chemical and placed under care of a physician. INGESTION: induce vomiting. EYES: flush with water for at least 15 min. SKIN: wash well with soap and water.
Threshold limit value: 0.5 mg/m(3) (as antimony)
Short term inhalation limits: Data not available
Toxicity by ingestion: Grade 0; oral rat LD(50) = 20,000 mg/kg
Late toxicity: Data not available
Vapor (gas) irritant characteristics: Data not available
Liquid or solid irritant characteristics: Data not available

Odor threshold: Odorless
IDLH value: 80 mg/m(3) as Sb

FIRE HAZARDS

Flash point: Not flammable
Flammable limits in air: Not flammable
Fire extinguishing agents: Not pertinent
Fire extinguishing agents NOT to be used: Not pertinent
Special hazards of combustion products: Data not available
Behavior in fire: Data not available
Ignition temperature: Not pertinent
Electrical hazard: Not pertinent
Burning rate: Not pertinent
Adiabatic flame temperature: Not pertinent
Stoichiometric air to fuel ratio: Not pertinent
Flame temperature: Not pertinent

CHEMICAL REACTIVITY

Reactivity with water: No reaction
Reactivity with common materials: Data not available
Stability during transport: Stable
Neutralizing agents for acids and caustics: Not pertinent
Polymerization: Not pertinent
Inhibitor of polymerization: Not pertinent
Molar ratio (reactant to product): Data not available
Reactivity group: Data not available

WATER POLLUTION

Aquatic toxicity: >80 ppm*/96 hr/fathead minnow/TLm/ hard or soft fresh water *as antimony
Waterfowl toxicity: Data not available
Biological oxygen demand (BOD): None
Food chain concentration potential: High

SHIPPING INFORMATION

Grades of purity: Reagent, 99.9+%; Optical grade
Storage temperature: Ambient
Inert atmosphere: No requirement
Venting: Open

HAZARD CLASSIFICATIONS

Code of federal regulations: ORM-E

NAS hazard rating for bulk water transportation: Not listed

NFPA hazard classification: Not listed

PHYSICAL AND CHEMICAL PROPERTIES

Physical state at 15 degrees C. and 1 ATM: Solid

Physical state at 15 degrees C. and 1 ATM: Solid
Molecular weight: 291.50
Boiling point at 1 ATM: Not pertinent
Freezing point: Not pertinent
Critical temperature: Not pertinent
Critical pressure: Not pertinent
Specific gravity: 5.2 at 25 degrees C (solid)
Liquid surface tension: Not pertinent
Liquid water interfacial tension: Not pertinent
Vapor (gas) specific gravity: Not pertinent
Ratio of specific heats of vapor (gas): Not pertinent
Latent heat of vaporization: Not pertinent
Heat of combustion: Not pertinent
Heat of decomposition: Not pertinent
Heat of solution: Not pertinent
Heat of polymerization: Not pertinent
Heat of fusion: 46.3 cal/g
Limiting value: Data not available
REID vapor pressure: Data not available

ANTIMONY TRIOXIDE

OHM/TADS - Oil and Hazardous Materials/Technical Assistance Data System

SUBSTANCES INCLUDED

Material name: ANTIMONY TRIOXIDE
Note: Listed in CERCLA ("Superfund" Act)
Synonyms: DIANTIMONY TRIOXIDE FLOWERS OF ANTIMONY SENARMONTITE VALENTINITE EXITELITE WEISSPIESSGLANZ ANTIMONY WHITE ANTIMONY OXIDE
CAS number: 1309-64-4
Chemical formula: SB2O3
SIC CODE: 2850; 2260
Tradename(s):
Production sites: AMERICAN CAN CO., M&T CHEMS. INC. SUBSID., BALTIMORE, MD. CHEMETRON CORP., INORGANIC AND METAL TREATING CHEMS. DIV;, CLEVELAND, OHIO KEWANEE OIL CO.. HARSHAW CHEM. CO. DIV., INDUST. CHEMS. DEPT., GLOUCESTER CITY, NJ; RICHARDSON-MERRELL, INC., J.T. BAKER CHEM. CO. SUBSID., PHILLIPSBURG, N.J. NYANZA INC., ASHLAND, MA. PPG INDUSTRIES, INC., CHEMICALS GROUP, SPECIALITY PRODUCTS UNIT. 12555 W. HIGGINS RD., P.O. BOX 66251-AMF OhARE, CHICAGO, IL 60666, (312) 694-2700
Species in mixture: TWO CRYSTALLINE FORMS BASED ON PARTICLE SIZE ARE SENARMONTITE (95% OF YIELD IN PROCESS) AND ORTHORHOMBIC VALENTINITE. FIRE SHIELD (BRANDI) FROM PPG COMES IN 3 FORMS: L GRADE 99.3%, 2.5 TO 3.5 MICRON PARTICLES; H GRADE 99.3%, 1.0 TO 1.8 MICRON PARTICLES; AND ULTRAFINE 99.3% .25 MICRON PARTICLES WITH IMPURITITES OF ARSENIC (<.5%), LEAD (.07%), IRON (.002%), AND SO4 (.015%). (SBO3** 79/PPG)

COMMON USES

REFINING AND COLORING OF GLASS; FLAME RETARDANT; GLASS-TO-GLASS AND GLASS-TO-METAL BONDS; SEMI-CONDUCTING CERAMICS AND GLAZES; INDUSTRIAL ESTERIFICATION CATALYST; PIGMENT WHITE 11; ALSO COLOR STABILIZER OR MIXER FOR OTHER PIGMENTS; PAPER COATINGS FOR X-RAY LUMINESCENCE; SYNERGISTIC WITH MOLYBDENUM DISULFIDE FOR SOLID FILM LUBRICANTS (SBO3** 79/PPG)

TRANSPORT/STORAGE/HANDLING

Transport:
Rail(%): 81.0
Barge(%): 3.0
Truck(%): 16.0
Storage:
General storage procedures: STORE IN COOL, WELL-VENTILATED PLACE (RMRNR* 12,73/OTT)
Handling:
General handling procedures: NOT CLASSIFIED BY DOT AS HAZARDOUS. (RMRNR* 12,73/OTT) RECOMMENDED USE ONLY WITH IMPERVIOUS LONG GAUNTLET GLOVES, CHEMICAL SAFETY GLASSES, DUST MASKS, AND APRONS. (RMRNR* 12,73/OTT)

LABORATORY

Field detection limits (ppm): .1, COLORIMETRIC, (BNW 70098)
Laboratory detection limits (ppm): .1, COLORIMETRIC, (BNW 70096)

PHYSICOCHEMICAL PARAMETERS

Physical parameters:

Location/state of material: COLORLESS, ORTHORHOMBIC, DELIQUESCENT CRYSTALS. SOLID WILL SINK AND DISSOLVE VERY SLOWLY.
Color in water: COLORLESS
Melting point (degrees C): 656
Melting characteristics: SAX*** 79/SAX
Boiling point (degrees C): 1425; 1550
Boiling characteristics: ITII** 80; SUBLIMES (SAX*** 79/SAX)
Specific gravity: 5.2 (SENARMONTITE); 5.67 (VALENTINITE) (SBO3** 79/PPG)
Vapor pressure (mm Hg): 1; 6
Vapor pressure text: 1 MM HG AT 574 DEGREES CELSIUS (SAX*** 79/SAX); 6 MM HG AT 666 DEGREES CELSIUS.

Chemical parameters:

Reactivity:
Binary reactants: SB2O3 HEATED IN AIR IGNITES AND BURNS. BRF8 AND SB2O3 REACT VIOLENTLY. (NFC*** 13,80/NFPA) REACTS WITH ORGANIC ACIDS, ALCOHOLS, GLYCOLS, .ALPHA.-HYDROXY ACIDS, .ORTHO.-DIHYDRIC PHENOLS, SUGAR ALCOHOLS, AND OTHER POLY HYDROXY COMPOUNDS. IT HAS CATALYTIC EFFECT ON ESTERIFICATION REACTIONS. WHEN FUNCTIONING AS A FLAME RETARDANT IT UNDERGOES REACTIONS WITH HYDROGEN HALIDES GENERATED BY THERMAL DECOMPOSITION OF HALOGENATED ORGANIC COMPOUNDS.
Water chemistry: SEE FILE ON ANTIMONY FOR SOLUTION CHEMISTRY.

FIRE/EXPLOSION/CORROSION HAZARDS

Fire hazard:
Flammability: NONFLAMMABLE
Standard codes: EPA 311; IMCO CODES NOT APPLICABLE FOR ANTIMONY OXIDES AND SULFIDES. (SBLIT* 76/ADL) SUPERFUND DESIGNATED (HAZARDOUS SUBSTANCES) LIST
Toxic combustion products: SB FUMES - WEAR SELF-CONTAINED BREATHING APPARATUS.
Personnel protection: IMPERVIOUS LONG GAUNTLET GLOVES, CHEMICAL SAFETY GOGGLES, APRONS AND FILTER-TYPE DUST RESPIRATOR (WHEN EXPOSURE EXCEEDS OSHA LIMITS). (SBO3** 79/PPG) SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. (ERG*** 80/DOT)
Explosion hazard:
Explosiveness: STABLE

ENVIRONMENTAL HAZARDS

Pollution hazard:

Water pollution:
Effect on water treatment process: WILL ADD GREATLY TO SLUDGE VOLUME
Water uses threatened: POTABLE SUPPLY, FISHERIES.
Air pollution: LITTLE AIR POLLUTION THREAT ON A SHORT-TERM BASIS.
Food chain:
Potential for accumulation: SB CAN BE CONCENTRATED 300 TIMES BY MARINE LIFE. POSITIVE, SB CONCENTRATION FACTORS - FRESHWATER AND MARINE INVERTEBRATES 16,000; AND FISH 40 . HALF-LIFE IN TOTAL HUMAN BODY 38 DAYS .
Food chain concentration: POSITIVE

Aquatic toxicity:

Freshwater toxicity text (Conc. in ppm):

Conc.	Expos (Hr)	Specie	Effect	Test Environment
> 80	96	FATHEAD MINNOW	TLM	HARD OR SOFT AS SB

Toxicity to animals:

Animal toxicity text (Value in mg of material/kg body wt):

Value	Time	Species	Param.	Route
SEE RTECS				

RANGE OF TOXICITY

Inhalation limit: .5

Inhalation limit text: MG/CU M AS SB.

Direct contact: NO IRRITATION TO CONJUNCTIVA OR CORNEA IN EYES OF RABBITS UP TO 7D AFTER INSTILLATION OF 1.3 +/- 1.65 MICRON-SIZE PARTICLES. NO LOCAL OR SYSTEMIC EFFECTS WHEN APPLIED AS AN AQUEOUS PASTE TO DENUDED RABBIT SKIN OVER TWO-THIRDS OF TORSO, COVERED WITH IMPERVIOUS MEMBRANE, AND ALLOWED TO REMAIN IN SKIN CONTACT FOR 1 WEEK. DRY POWDER PACKED INTO SHAVED RABBIT BACKS DELAYED HEALING (SBLIT* 76/ADL) ANTIMONY TRIOXIDE HAS BEE KNOWN TO CAUSE "ANTIMONY SPOTS", A DERMATITIS RESULTING FROM EXPOSURE OF THE SKIN, MOISTENED BY SWEAT AND HUMIDITY, TO ANTIMONY DUSTS. RESULTS IN INTENST ITCHING AND SKIN ERUPTIONS. ANTIMONY COMPOUNDS ARE GENERALLY LESS TOXIC THAN ANTIMONY SO SOME TOXIC SYMPTOMS ARE REALLY DUE TO THE PRESENCE OF FREE ANTIMONY. (OCDIS* 77/KEY)

General sensation: ODORLESS, TASTELESS. EFFECTS APPEAR TO BE REVERSIBLE.

Direct human ingestion (mg/kgwt): 70

HUMAN HEALTH HAZARDS

Acute hazard level: SB2O3 IS RELATIVELY HARMLESS WHEN INGESTED. FOR EXAMPLE, A ONE-TIME ORAL DOSE OF 16 G CAUSED NO ILL EFFECTS IN RATS WITHIN A 30-D OBSERVATION PERIOD. GROSS ET AL., 1955A, CITED IN (SBLIT* 76/ADL) PROBABLY ALSO RELATIVELY HARMLESS A BRIEF INHALATION PERIOD. FOR EXAMPLE, HAMSTERS AND RATS EXPOSED TO 900 OR 1,200 MG SB2O3 PER CU M FOR 12 H SHOWED ONLYAN INCREASE IN NUMBER OF LUNG MACROPHAGES. GROSS ET AL., 1969, CITED IN (SBLIT* 76/ADL)

Chronic hazard level: MARINE WATERS SHOULD NOT EXCEED 1/50 OF 96-H LC50 (.2 PPM). UNDISSOLVED PORTION WILL PROVIDE CONTINUING SOURCE OF SB TO WATER. DAILY DOSES OF .15 TO 4 MG PER RABBIT OR RAT PER DAY HAD NO EFFECTS. FLURY, 1927, CITED IN (INDTO* 61/BRO) CHRONIC INHALATION EXPOSURES AT 89 TO 1,700 MG/CU M WITH RATS AND RABBITS FOR UP TO 14.5 MO SHOWED PHAGOCYTIC RESPONSE WITHOUT APPRECIABLE CHRONIC PNEUMONITIS; MILD HYPERPLASIA IN TRACHEOBRONCHIAL LYMPH NODES; LUNG DEPOSITS OF ANTIMONY, FIBROSIS; AND , IN ONE SERIES OF EXPERIMENTS, 18-85% DEATHS DUE TO PNEUMONIA WITH PRECEDING PNEUMONITIS. (NIOSB* 78/ANO) THE DEATHS WERE SEEN WHEN THE EXPOSURES WERE AS LONG AS 25 H/WEEK. OCCUPATIONAL EXPOSURE TO ANTIMONY TRIOXIDE (AND FREQUENTLY ORES AND SMELTER PRODUCTS CONTAINING OTHER HEAVY METAL CONTAMINANTS) IS ASSOCIATED WITH PNEUMOCONIOSIS, POSSIBLE INCREASED RISK OF LUNG CANCER, MILD DERMATITIS, AND SLIGHT ANISOCYTOSIS. THERE IS REPORT BY LINCK ET AL., (1976) OF A NO-OBSERVED EFFECT IN WORKERS EXPOSED TO ANTIMONY TRIOXIDE AT LEVELS SIMILAR TO THOSE REPORTED TO PRODUCE PNEUMOCONIOSISIN ANOTHER STURDY. (NIOSB* 78/ANO)

Public health hazard: MINIMAL HAZARD TO PUBLIC HEALTH IF ONLY A SHORT-TERM EXPOSURE TO THE DUSTS.

Action levels: IF INTENSE HEAT OR FLAME PREVAIL, NOTIFY AIR AUTHORITY.

P42.A9

Teratogenicity: NOT TERATOGENIC BUT TOXIC TO REPRODUCTIVE FUNCTION: FEMALE RATS EXPOSED TO 250 MG SB2O3 DUST PER CU M FOR 4H/D FOR 1.5 TO 2 MO. SHOWED REDUCED FECUNDITY AND REDUCED NUMBERS OF VIABLE OFFSPRING. BELYAEVA, 1967, CITED IN (NIOSB* 78/ANO)

CLEANUP PROCEDURES

In situ amelioration: OXIDE IS ONLY SLIGHTLY SOLUBLE, SOLUBILITY GOES DOWN AS PH RISES. DREDGE SOLIDS FROM BOTTOM. MAY BE ADVISABLE TO RAISE PH WITH LIME. ANTIMONY OXIDE SPILLS SHOULD BE VACUUMED AWAY AND DISPOSED OF IN AN APPROVED HAZARDOUS WASTE FACILITY. (SBO3** 79/PPG) SEEK PROFESSIONAL ENVIRONMENTAL ENGINEERING ASSISTANCE THROUGH EPA'S ENVIRONMENTAL RESPONSE TEAM (ERT), EDISON, NJ, 24-HOUR NO. 201-321-6660.
Countermeasure material availability: LIME - CEMENT PLANTS.
Disposal method(s): SB2O3 CAN BE DISCARDED IN MUNICIPAL SYSTEMS. IT IS NOT CONSIDERED TO BE A POLLUTION PROBLEM. (ENVTAR 13(8)18,71/SCH) (ESTHAG 5(5)436,71/MUR) THE PRECIPITATE, DRY, PACKAGE AND SHIP TO THE SUPPLIER OR IF THE WASTE IS OF VERY LITTLE VALUE, USE PROCEDURE 11.

DATA ADEQUACY EVALUATION

FAIR